Risks of Iprodione Use to Federally Threatened California Red-legged Frog
(*Rana aurora draytonii*)

Pesticide Effects Determination

Environmental Fate and Effects Division
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1.0 Executive Summary

The purpose of this assessment is to evaluate potential direct and indirect effects on the California red-legged frog *(Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding use of iprodione on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in modification of the species' designated critical habitat. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998) and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004).

The CRLF was listed as a threatened species by USFWS in 1996. The species is endemic to California and Baja California (Mexico) and inhabits both coastal and interior mountain ranges. A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS, 1996) in California.

Iprodione is a fungicide that is currently registered for use in California for 37 different agricultural crops. Agricultural uses include almonds, stone fruits, beans, caneberries, bushberries, canola, cole crops, carrots, cotton, crucifer, garlic, grapes, lettuce, onions, peanuts, potatoes, radish, rutabaga, strawberries and turnip greens. Applications to agricultural uses can be made via several different application methods, including ground spray, spray by aircraft, chemigation, soil, in furrow treatment, dip treatment and seed treatment. The maximum single application rate varies by the specific agricultural use and ranges 0.27-1.37 lbs a.i./A. Iprodione is also used as a seed treatment on several agricultural crops. It should be noted that some formulated product labels for iprodione allow for the use of iprodione on ginseng in California; however, based on analysis of National Agricultural Statistics Service (NASS) data, ginseng is not grown in California and is therefore, not relevant to this assessment. In addition, iprodione is registered for several non-agricultural uses, including conifers, turf grass (golf courses, sod farms and commercial industrial lawns) and ornamentals. Use of iprodione in residential areas (e.g., turf and ornamentals) is prohibited. For turf, maximum single applications as high as 8.16 lbs a.i./A can be made (to golf courses). For ornamentals, a maximum single application of 22.44 lbs a.i./A can be made by drench. Iprodione labels indicate that applications to areas adjacent to water bodies (including lakes, reservoirs, rivers, streams, marshes, natural ponds, commercial fish ponds and estuaries) should only be made where a 25 foot vegetated buffer strip exists.

Laboratory and field data indicate that parent iprodione dissipates in the environment by hydrolysis, leaching, and runoff. Iprodione is not expected to volatilize. As such, the major routes of transport for iprodione are expected to be spray drift and runoff. Six major degradates[1] of iprodione have been identified in laboratory environmental fate studies, and an additional degradate has been identified in field studies. One of these major degradates is 3,5-dichloroaniline (3,5-DCA), which is the ultimate degradation product of all of the major degradates of iprodione. It should be noted that 3,5-DCA can also be formed from the active

[1] A major degradate is one that is measured in a laboratory fate study as ≥ 10% of the applied parent.

ingredient vinclozolin which is also a fungicide. Vinclozolin is registered in the U.S. where its only two remaining uses are on canola (excluded in CA) and turf.

For the purpose of this assessment, iprodione as well as 3,5-DCA are considered to be of concern for posing risks to non-target organisms. Because all other major degradates of iprodione contain the 3,5-DCA moiety, the other major degradates of iprodione are also considered to be of concern. There is a great deal of uncertainty associated with this approach because: 1) there is a limited amount of toxicity data available for 3,5-DCA, compared to that of iprodione; 2) there are no identified toxicity data for the major degradates that are intermediaries between iprodione and 3,5-DCA; and 3) it is unknown whether or not iprodione and its degradates share a common mode of action.

Since CRLFs exist within aquatic and terrestrial habitats, exposure of the CRLF, its prey and its habitats to iprodione are assessed separately. Tier-II aquatic exposure models are used to estimate high-end exposures of iprodione in aquatic habitats resulting from runoff and spray drift from different uses. Peak model-estimated environmental concentrations for iprodione (only) in surface water resulting from different iprodione uses range from 1.07 to 820 µg/L. For 3,5-DCA, peak estimates range 2.2 to 461 µg/L. These estimates are supplemented with analysis of available California surface water monitoring data from U. S. Geological Survey's National Water Quality Assessment (NAWQA) program. The maximum concentration of iprodione reported by NAWQA for California surface waters with agricultural watersheds is 141 µg/L. This value is relatively consistent with model-estimated 1-in-10 year peak environmental concentrations for iprodione. No data were available for iprodione in the California Department of Pesticide Regulation surface water database. Monitoring data for the primary degradate of iprodione, *i.e*., 3,5-DCA, indicate a maximum of 0.027 µg/L; however, environmental detections of 3,5-DCA cannot necessarily be attributed to iprodione, since it is not the only source of 3,5-DCA in the environment.

To estimate iprodione exposures to the terrestrial-phase CRLF, and its potential prey resulting from uses involving iprodione applications, the T-REX model is used for foliar uses. The T-HERPS model is used to allow for further characterization of dietary exposures of terrestrial-phase CRLFs relative to birds. The AgDRIFT model is also used to estimate deposition of iprodione on terrestrial and aquatic habitats from spray drift.

The effects determination assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF itself, as well as indirect effects, such as reduction of the prey base or modification of its habitat. Direct effects to the CRLF in the aquatic habitat are based on toxicity information for freshwater fish, which are generally used as a surrogate for aquatic-phase amphibians. In the terrestrial habitat, direct effects are based on toxicity information for birds, which are used as a surrogate for terrestrial-phase amphibians. Given that the CRLF's prey items and designated critical habitat requirements in the aquatic habitat are dependant on the availability of freshwater aquatic invertebrates and aquatic plants, toxicity information for these taxonomic groups is also discussed. In the terrestrial habitat, indirect effects due to depletion of prey are assessed by considering effects to terrestrial insects, small terrestrial mammals, and frogs. Indirect effects due to modification of the terrestrial habitat are characterized by available data for terrestrial monocots and dicots; however, these effects cannot be quantified due to a lack of terrestrial plant toxicity data for iprodione.

Iprodione is moderately toxic to freshwater fish and highly toxic to invertebrates on an acute exposure basis. The no observed adverse effect concentration (NOAEC) for chronic effects to the fathead minnow is 260 µg/L, with a lowest observed adverse affect concentration (LOAEC) of 550 µg/L based on reductions in larval survival. Available chronic toxicity data for aquatic invertebrates include a NOAEC of 170 µg/L, with a LOAEC of 330 µg/L based on reduction in growth, survival and number of offspring. The EC_{50} for algae exposed to iprodione is 50 µg/L, based on effects to growth. For aquatic vascular plants, the EC_{50} is >12,640 µg/L, based on effects to growth.

Iprodione is slightly toxic to birds on an acute oral basis and practically non-toxic on a subacute dietary exposure basis. Iprodione is also practically non-toxic to mammals on an acute oral exposure basis and to honey bees on an acute contact basis. The NOAEC for chronic effects to the Northern bobwhite quail is 300 mg/kg-diet, with a LOAEC of 1000 mg/kg-diet based on reduced number of eggs laid, decreased hatchling body weight and decreased number of hatchlings per number of eggs set. For mammals, the NOAEL is 150 ppm (6.1 in males and 8.4 mg/kg/day in females) based on a chronic study with rats where the LOAEL is 300 ppm (12.4 in males and 16.5 mg/kg/day in females), based on reduced spermatozoa in the epididymides and reduced secretion of the seminal vesicles of males. The effects of iprodione on sperm and semen production are considered effects that could potentially reduce male fertility and impact reproductive success in mammals. According to the iprodione RED (USEPA 1998b), iprodione is classified as a Group B2, *i.e.*, it is considered a “likely” carcinogen, based on evidence of tumors in both sexes of mouse [hepatocellular adenoma/carcinoma] and in the male rat [Leydig cell].

A limited amount of toxicity data have been identified for characterizing the effects of 3,5-DCA on non-target organisms and based on these data, 3,5-DCA is classified as moderately toxic to aquatic organisms on an acute exposure basis. The degradate is also classified as a carcinogen because of its structural similarity to *para*-chloroaniline, which is a known carcinogen. No additional data have been identified to characterize the toxicity of other major degradates of iprodione to non-target organisms.

Risk quotients (RQs) are derived as quantitative estimates of potential high-end risk. Acute and chronic RQs are compared to the Agency’s levels of concern (LOCs) to identify instances where iprodione use within the action area has the potential to adversely affect the CRLF and its designated critical habitat via direct toxicity or indirectly based on direct effects to its food supply (*i.e.*, freshwater invertebrates, algae, fish, frogs, terrestrial invertebrates, and mammals) or habitat (*i.e.*, aquatic plants and terrestrial upland and riparian vegetation). When RQs for each particular type of effect are below LOCs, the pesticide is determined to have “no effect” on the CRLF. Where RQs exceed LOCs, a potential to cause adverse effects is identified, leading to a conclusion of “may affect.” If a determination is made that use of iprodione use within the action area “may affect” the CRLF and its designated critical habitat, additional information is considered to refine the potential for exposure and effects, and the best available information is used to distinguish those actions that “may affect, but are not likely to adversely affect” (NLAA) from those actions that are “likely to adversely affect” (LAA) the CRLF and its critical habitat.

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the CRLF from the uses of iprodione in California. Additionally, the Agency has determined that there is the potential for modification of CRLF designated critical habitat from the uses of the chemical. Summaries of the risk conclusions and supporting rationales for the effects determinations for the CRLF and its critical habitat are presented in **Table 1** and **Table 2**, respectively. Use-specific determinations for direct and indirect effects to the CRLF are provided in **Table 3** and in **Table 4**. Given the LAA determination for the CRLF and potential modification of designated critical habitat, a description of the baseline status and cumulative effects for the CRLF is provided in **Attachment II**.

Table 1. Effects Determination Summary for Iprodione Use and the CRLF.

Assessment Endpoint	Effects Determination	Basis for Determination
Survival, growth, and/or reproduction of CRLF individuals	Likely to adversely affect (LAA) for all uses	**Potential for Direct Effects**
		Aquatic-phase (Eggs, Larvae, and Adults): Acute RQs based on **iprodione residues of concern** for aquatic-phase CRLF are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21 x10^{35}). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1. Chronic RQs for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (*i.e*., cotton and garlic) and seed treatments do not exceed LOCs. If RQs were developed using EECs for iprodione only and for 3,5-DCA only, for high use on ornamentals (26 applications per year), they would be sufficient to exceed acute and chronic LOCs for the aquatic-phase CRLF. There is an incident report involving a fish kill associated with the use of iprodione on golf course turf.
		Terrestrial-phase (Juveniles and Adults): Preliminary acute RQs (generated using T-REX) exceed the level of concern for all uses of iprodione, except cotton. Refined acute, dose-based RQs (generated using T-HERPS) for the small CRLF consuming small insects exceed the LOC for drench applications of iprodione on ornamentals. The likelihood of individual mortality to small CRLF exposed to iprodione from drench applications ranges 1 in 10 to 1 in 8.9x10^{18}. Refined acute, dose-based RQs for the medium CRLF consuming small herbivore mammals exceed the LOC for all uses of iprodione, except cotton. The likelihood of individual mortality for the medium CRLF is as high as 1 in 1. Refined acute, dose-based RQs for the large CRLF exceed the LOC for iprodione use on canola, cole crops, conifers, crucifer, ornamentals, rutabagas, turf and turnip greens. The likelihood of individual mortality for the large CRLF is as high as 1 in 1. Preliminary chronic (dietary-based) RQ values generated using T-REX ranged from 1.04 to 38.6 across 19 of the 24 use categories evaluated. Revised chronic RQs for at least one prey item generated using T-HERPS exceed the LOC (1.0) for every use of iprodione, except almonds, cotton and strawberries. In addition, EECs for iprodione use on ornamentals and turf are sufficient to exceed the LOAEC. For all uses of iprodione, spray drift exposure is of concern <37 feet from the edge of the application site.
		Potential for Indirect Effects
		Aquatic prey items, aquatic habitat, cover and/or primary productivity RQs for non-vascular plants are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow

Assessment Endpoint	Effects Determination	Basis for Determination
		treatment to cotton and all seed treatments are below the LOC. All aquatic invertebrate RQs for uses where iprodione is applied via ground spray, chemigation or aerial spray are sufficient to exceed acute and chronic LOCs Acute RQs based on **iprodione residues of concern** for fish and aquatic-phase amphibians are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21 $x10^{35}$). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1. Chronic RQs for fish and aquatic-phase amphibians are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (*i.e.*, cotton and garlic) and seed treatments do not exceed LOCs. Based on the above information, there is potential for indirect effects to the aquatic-phase CRLF from use of iprodione.
		Terrestrial prey items, riparian habitat Acute risk to terrestrial invertebrates could potentially exceed the LOC for uses of iprodione on ornamental plants and turf. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Chronic RQ values exceed the chronic risk LOC for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF. There is considerable uncertainty regarding the effects of iprodione on terrestrial invertebrates and based on incident data, risk is presumed. There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants.

Table 2. Effects Determination Summary for Iprodione Use and CRLF Critical Habitat Impact Analysis.

Assessment Endpoint	Effects Determination	Basis for Determination
Modification of aquatic-phase PCE	Habitat Modification	There is uncertainty (due to a lack of effects data for plants) regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants. RQs for non-vascular plants that may serve as a forage base for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow treatment to cotton and all seed treatments are below the LOC. All aquatic invertebrate RQs for uses where iprodione is applied via ground spray, chemigation or aerial spray are sufficient to exceed acute and chronic LOCs Acute RQs based on **iprodione residues of concern** for fish and aquatic-phase amphibians are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21 $x10^{35}$). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1. Chronic RQs for fish and aquatic-phase amphibians are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments do not exceed LOCs.
Modification of terrestrial-phase PCE		There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide cover for the terrestrial environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants. Acute risk to terrestrial invertebrates could potentially exceed the level of concern for uses of iprodione on ornamental plants and turf. Additionally, there is uncertainty regarding the potential effects of iprodione on larval terrestrial invertebrates and risk is presumed based on an incident report. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Chronic RQ values exceed the chronic risk LOC for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF. Dietary-based chronic RQ values exceed the chronic risk LOC for terrestrial-phase amphibians by factors as high as 28X and as such, available mammalian prey items may be reduced in CRLF habitat.

Table 3. LOC exceedances by direct effects RQs for the CRLF exposed to iprodione residues of concern through iprodione applications via ground spray, soil in-furrow, chemigation or aerial methods.

Use(s)	Aquatic Habitat		Terrestrial Habitat	
	Acute	Chronic	Acute	Chronic
Almonds	**YES**	no	**YES**	no
Beans	**YES**	no	**YES**	no
Berries[1]	**YES**	**YES**	**YES**	**YES**
Canola	**YES**	**YES**	**YES**	**YES**
Carrots	**YES**	**YES**	**YES**	**YES**
Cole crops[2]	**YES**	**YES**	**YES**	**YES**
Conifers	**YES**	**YES**	**YES**	**YES**
Cotton	no	no	no	no
Crucifer	**YES**	**YES**	**YES**	**YES**
Garlic	no	no	**YES**	no
Grapes	**YES**	**YES**	**YES**	**YES**
Lettuce	**YES**	**YES**	**YES**	**YES**
Onions	**YES**	**YES**	**YES**	**YES**
Ornamentals	**YES**	**YES**	**YES**	**YES**
Peanuts	**YES**	no	**YES**	**YES**
Potatoes	**YES**	**YES**	**YES**	**YES**
Radishes	**YES**	**YES**	**YES**	**YES**
Rutabagas	**YES**	**YES**	**YES**	**YES**
Stone fruit[3]	**YES**	no	**YES**	**YES**
Strawberries	**YES**	no	**YES**	no
Turf [4]	**YES**	**YES**	**YES**	**YES**
Turnip greens	**YES**	**YES**	**YES**	**YES**

[1] specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[2] specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3] specifically, apricots, cherries, nectarines, peaches, plums, prunes
[4] golf course, sod farm, commercial industrial lawns

Table 4. LOC exceedances by indirect effects RQs for prey (of the CRLF) exposed to iprodione residues of concern through iprodione applications via ground spray, soil in-furrow, chemigation or aerial methods.

Use(s)	Algae	Aquatic Invertebrates		Terrestrial Invertebrates (Acute)	Aquatic-phase frogs and fish		Terrestrial-phase frogs		Small Mammals	
		Acute	Chronic		Acute	Chronic	Acute	Chronic	Acute	Chronic
Almonds	**YES**	**YES**	**YES**	no	**YES**	no	**YES**	no	no	**YES**
Beans	**YES**	**YES**	**YES**	no	**YES**	no	**YES**	no	no	**YES**
Berries[1]	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Canola	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Carrots	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Cole crops[2]	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Conifers	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Cotton	no	no	no	no	no	no	no	no	no	**YES**
Crucifer	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Garlic	**YES**	**YES**	no	no	no	no	**YES**	no	no	**YES**
Grapes	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Lettuce	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Onions	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Ornamentals	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Peanuts	**YES**	**YES**	**YES**	no	**YES**	no	**YES**	**YES**	no	**YES**
Potatoes	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Radishes	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Rutabagas	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**
Stone fruit[3]	**YES**	**YES**	**YES**	no	**YES**	no	**YES**	**YES**	no	**YES**
Strawberries	**YES**	**YES**	**YES**	no	**YES**	no	**YES**	no	no	**YES**
Turf [4]	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Turnip greens	**YES**	**YES**	**YES**	no	**YES**	**YES**	**YES**	**YES**	no	**YES**

[1] Specifically: blackberries, blueberries, caneberries, currants elderberries, gooseberries, huckleberries, loganberries, raspberries
[2] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3] Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[4] golf course, sod farm, commercial industrial lawns

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (*i.e.*, food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e.*, attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

2.0 Problem Formulation

Problem formulation provides a strategic framework for the risk assessment. By identifying the important components of the problem, it focuses the assessment on the most relevant life history stages, habitat components, chemical properties, exposure routes, and endpoints. The structure of this risk assessment is based on guidance contained in U.S. EPA's Guidance for Ecological Risk Assessment (U.S. EPA 1998), the Services' Endangered Species Consultation Handbook (USFWS/NMFS 1998) and is consistent with procedures and methodology outlined in the Overview Document (U.S. EPA 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS/NMFS 2004).

2.1 Purpose

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the federally threatened California red-legged frog (*Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding agricultural and nonagricultural uses of iprodione (see use characterization for specific uses). In addition, this assessment evaluates whether these uses expected to result in modification of the species' designated critical habitat. This ecological risk assessment has been prepared consistent with a settlement agreement in the case Center for Biological Diversity (CBD) vs. EPA et al. (Case No. 02-1580-JSW(JL)) settlement entered in Federal District Court for the Northern District of California on October 20, 2006.

In this assessment, direct and indirect effects to the CRLF and potential modification to its designated critical habitat are evaluated in accordance with the methods described in the Agency's Overview Document (U.S. EPA 2004). Screening level methods include use of standard models such as PRZM-EXAMS, T-REX, and AgDRIFT, all of which are described in the Overview Document. Additional refinements include use of the T-HERPS model. Use of such information is consistent with the methodology described in the Overview Document (U.S. EPA 2004), which specifies that "the assessment process may, on a case-by-case basis, incorporate additional methods, models, and lines of evidence that EPA finds technically appropriate for risk management objectives" (Section V, page 31 of U.S. EPA 2004).

In accordance with the Overview Document, provisions of the ESA, and the Services' Endangered Species Consultation Handbook, the assessment of effects associated with registrations of iprodione is based on an action area. The action area is the area directly or indirectly affected by the federal action, as indicated by the exceedance of the Agency's Levels of Concern (LOCs). It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of iprodione may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on relevant sections of the action area including those geographic areas associated with locations of the CRLF and its designated critical habitat within the state of California. As part of the "effects determination," one of the following three conclusions will be reached regarding the potential use of iprodione in accordance with current labels:

- "No effect";
- "May affect, but not likely to adversely affect"; or

- “May affect and likely to adversely affect”.

Designated critical habitat identifies specific areas that have the physical and biological features, (known as primary constituent elements or PCEs) essential to the conservation of the listed species. The PCEs for CRLFs are aquatic and upland areas where suitable breeding and non-breeding aquatic habitat is located, interspersed with upland foraging and dispersal habitat.

If the results of initial screening-level assessment methods show no direct or indirect effects (no LOC exceedances) upon individual CRLFs or upon the PCEs of the species’ designated critical habitat, a “no effect” determination is made for use of iprodione as it relates to this species and its designated critical habitat. If, however, potential direct or indirect effects to individual CRLFs are anticipated or effects may impact the PCEs of the CRLF’s designated critical habitat, a preliminary “may affect” determination is made for the FIFRA regulatory action regarding iprodione.

If a determination is made that use of iprodione within the action area(s) associated with the CRLF “may affect” this species or its designated critical habitat, additional information is considered to refine the potential for exposure and for effects to the CRLF and other taxonomic groups upon which these species depend (*e.g.*, aquatic and terrestrial vertebrates and invertebrates, aquatic plants, riparian vegetation, etc.). Additional information, including spatial analysis (to determine the geographical proximity of CRLF habitat and iprodione use sites) and further evaluation of the potential impact of iprodione on the PCEs is also used to determine whether modification of designated critical habitat may occur. Based on the refined information, the Agency uses the best available information to distinguish those actions that “may affect, but are not likely to adversely affect” from those actions that “may affect and are likely to adversely affect” the CRLF or the PCEs of its designated critical habitat. This information is presented as part of the Risk Characterization in Section 5 of this document.

The Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because iprodione is expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for iprodione is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes (i.e., the biological resource requirements for the listed species associated with the critical habitat or important physical aspects of the habitat that may be reasonably influenced through biological processes). Activities that may modify critical habitat are those that alter the PCEs and appreciably diminish the value of the habitat. Evaluation of actions related to use of iprodione that may alter the PCEs of the CRLF’s critical habitat form the basis of the critical habitat impact analysis. Actions that may affect the CRLF’s designated critical habitat have been identified by the Services and are discussed further in Section 2.6.

2.2 Scope

Iprodione is a non-systemic fungicide currently registered in the United States for use on a variety of fruits, vegetables and ornamentals. These uses are considered as part of the federal action evaluated in this assessment.

The end result of the EPA pesticide registration process (*i.e.*, the FIFRA regulatory action) is an approved product label. The label is a legal document that stipulates how and where a given pesticide may be used. Product labels (also known as end-use labels) describe the formulation type (*e.g.*, liquid or granular), acceptable methods of application, approved use sites, and any restrictions on how applications may be conducted. Thus, the use or potential use of iprodione in accordance with the approved product labels for California is "the action" relevant to this ecological risk assessment.

Although current registrations of iprodione allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of iprodione in portions of the action area that are reasonably assumed to be biologically relevant to the CRLF and its designated critical habitat. Further discussion of the action area for the CRLF and its critical habitat is provided in Section 2.7.

Laboratory and field data indicate that parent iprodione dissipates in the environment by hydrolysis, leaching, and transport with water. Iprodione is not expected to volatilize. As such, the major routes of transport are expected to be spray drift and runoff. Although iprodione has several major degradates, the compound ultimately degrades to 3,5-dichloroaniline (3,5-DCA). This compound is classified as a carcinogen because of its structural similarity to *para*-chloroaniline, which is a known carcinogen. It should be noted that 3,5-DCA can also be formed from the fungicide vinclozolin. Vinclozolin is registered in the U.S. where its only two remaining uses are on canola (prohibited by labels for use in CA) and turf. According to CA PUR data, vinclozolin use in CA (10^2 lbs/year) is likely to be orders of magnitude less than iprodione (10^5 lbs/year, see section 2.4.3).

For the purpose of this assessment, iprodione as well as 3,5-DCA are considered to be of concern for posing risks to non-target organisms. Because all other major degradates of iprodione contain the 3,5-DCA moiety, the other major degradates of iprodione are also considered to be of concern. There is a great deal of uncertainty associated with this approach because: 1) there is a limited amount of toxicity data available for 3,5-DCA, compared to that of iprodione; 2) there are no identified toxicity data for the major degradates that are intermediaries between iprodione and 3,5-DCA; and 3) it is unknown whether or not iprodione and its degradates share a common mode of action.

The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (U.S., EPA 2004; USFWS/NMFS 2004). No environmental mixture studies involving iprodione were identified in the scientific literature using ECOTOX.

Iprodione has several registered products that contain multiple active ingredients. All but one of these products contain iprodione in combination with the fungicide thiophinate-methyl (CAS 23564-05-8). The one other product contains iprodione co-formulated with trifloxystrobin (CAS 141517-21-7). Data are available to assess the hazard associated with products co-formulated with thiophinate-methyl but not trifloxystrobin. The available data indicate that the formulated products have similar toxicity to that of technical grade iprodione alone.

2.3 Previous Assessments

Iprodione was registered for use on ornamentals and turf in 1981, on stone fruits in 1982, on potatoes in 1994, and on snap beans on 1997. The 1997 assessment noted that chronic toxicity studies were unavailable for aquatic animals; however, chronic exposure to birds and mammals resulted in reproductive effects that were characterized as anti-androgenic and indicative of a chemical acting on endocrine-mediated processes.

Several Section 18 emergency exemptions have been granted for the use of iprodione on caneberries in Washington State (1985), on canola (1997) in North Dakota and Minnesota, and on almonds in California (2007). In these assessments risk of acute mortality were identified for freshwater invertebrates and for birds, reptiles, terrestrial-phase amphibians and mammals; risk of chronic effects were identified for mammals.

In the 2000 reregistration RED, iprodione is classified as a Group C chemical (possible human carcinogen). The terminal metabolite of iprodione, 3,5-DCA, is considered to have a genotoxic mode of tumor induction based on its similarity to its structural analog *para*-chloraniline, which is carcinogenic in mammals.

In 2007, an Inter-Regional 4 (IR-4) petition for the new use of iprodione on pistachios and for revised application rates for use on strawberries, stone fruits and grapes and additional uses on canola, pistachios and almonds were evaluated. The evaluation concluded that based on the newly proposed uses on pistachios, almonds and canola and the revised use rates on strawberries, stone fruits and grapes, acute risk levels of concern for endangered species were exceeded for both terrestrial and aquatic animals.

2.4 Stressor Source and Distribution

2.4.1 Environmental Fate Assessment

Iprodione is moderately mobile (per FAO classification system) in soil systems with an organic carbon partition coefficient (K_{oc}) of approximately 500 mL/g. It is not particularly volatile; therefore, it should not be subject to long-range atmospheric transport. Iprodione is most persistent in acidic environments, with approximate half lives of 131 days at a pH of 5 in aquatic systems; however, in neutral aquatic systems, the half life drops to 4.7 days (pH of 7), and in basic systems, iprodione quickly dissipates (27 minutes at pH of 9). For aquatic systems, there is no strong evidence of effective mechanisms of iprodione degradation other than hydrolysis. The physical and chemical properties of iprodione and 3,5-DCA are provided in **Table 5.** The environmental fate and transport data relevant to iprodione are summarized below and in **Table 6.** The structure of iprodione is provided in **Figure 1.**

The major degradates observed in laboratory and field studies are summarized in **Table 7.** The table also shows the fate studies that produced the degradates and the maximum percent of parent at which each of the degradates appeared in the studies. The only degradate that the Health Effects Division has reported to be of toxicological concern is 3,5-dichloroaniline (3,5-DCA or RP-32596), and it was found in several of the laboratory studies. This assessment includes consideration for the exposure of both iprodione and 3,5-DCA.

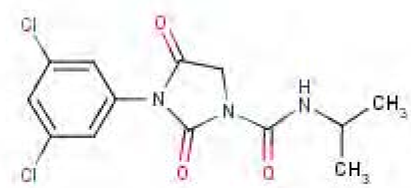


Figure 1. Chemical Structure of Iprodione

Table 5. Physical and chemical properties of iprodione and 3,5-DCA.

Parameter (units)	Iprodione[2]	3,5-DCA[3]
Molecular weight (g/mol)	330.2	162.02
Vapor Pressure (torr)	$2.7x10^{-7}$	2.12×10^{-2}
Henry's Law Constant (atm-m^3/mol)[1]	$9.0x10^{-9}$	5.8×10^{-6}
Solubility in Water (mg/L; @20^{o}C)	13	784
Octanol-water partition coefficient (Kow)	1259	794

[1] Calculated according to USEPA 2002*b* by: (VP *MW)÷(760*solubility).
[2] From registrant-submitted product chemistry data.
[3] EPISuite

Table 6. Environmental fate data relevant to iprodione.

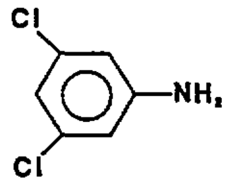
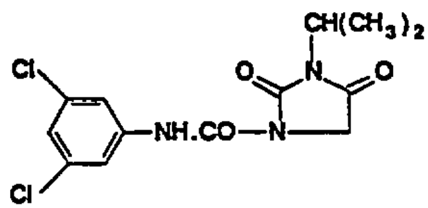
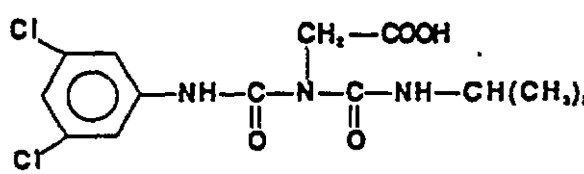
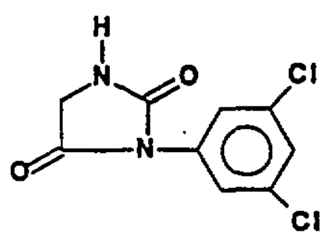
Parameter (units)	Value(s)	Source (MRID)
Hydrolysis Half-lives (d) pH 5 pH 7 pH 9	 131 4.7 0.019 (27 min)	41885401
Aqueous Photolysis Half-life (d)	67	41861901
Soil Photolysis Half –life (d)	negligible	42897101
Aerobic Soil Metabolism Half-life (d)	30 to 300[1] 24 to 100[2]	43091002 44590501
Anaerobic Soil Metabolism Half-life (d)	Not available	
Aerobic aquatic metabolism half-life (d)	3-7[3]	41927601 42503801
Anaerobic aquatic metabolism half-life (d)	7-14 [3]	41755801

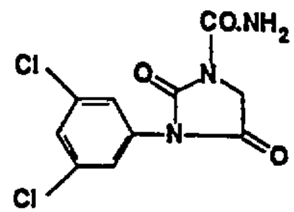
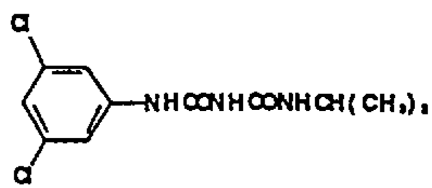
1The DT_{50} of the extracted iprodione was 14-30 days. It is difficult to estimate actual degradation rates from this study because unextracted and uncharacterized residues accounted for >75% of the applied ^{14}C at 181-276 days (last test interval). The half life could be higher than 300 days if all the unidentified unextracted material were iprodione.

[2]The shorter half life was based on the regression of extractable iprodione only. The longer half life was based on the observation that at 100 days there was more than 50% unrecovered and uncharacterized material that could have been iprodione.

[3]Degradation of iprodione was most likely driven by hydrolysis.

Table 7. Iprodione degradates observed in environmental fate studies.

Chemical Name	Registrant Name of degradate	Chemical Structure	Study in Which Found (Maximum % of Parent)	Reference MRID
3,5-dichloroaniline (or 3,5-DCA)	RP32596		Soil Photolysis (28%)* Aerobic Soil (9%) Aerobic Soil (3.9%) Aerobic Aquatic (10%) Anaerobic Aquatic (3.6%)	42897101 43091002 44590501 42503801 41755801
3-(1-methylethyl)-N-(3,5-dichlorophenyl)-2,4-dioxo-1-imidazolidine-carboxamide	RP30228		Hydrolysis (pH 7) (45.6%) Hydrolysis (pH 9) (93%) Soil Photolysis (7.7%) Aerobic Soil (29%) Aerobic Aquatic (65%) Anaerobic Aquatic (60%) Terrestrial Field (--) Aquatic Field (--)	41885401 42897101 44590501 42503801 41755801 41877401 43718301
[(dichloro-3,5-phenyl)-1-isopropylcarbamoyl-3]-2-acetic acid	RP35606		Hydrolysis (pH 5) (12%) Hydrolysis (pH 7) (10.1%)	41885401
3-(3,5-dichlorophenyl)-2,4-dioxoimidazolidine	RP25040		Soil Photolysis (14%) Aerobic Soil (9.5%)	42897101 43091002

Chemical Name	Registrant Name of degradate	Chemical Structure	Study in Which Found (Maximum % of Parent)	Reference MRID
3-(3,5-dichlorophenyl)-2,4-dioxo-1-imidazolidine-carboxamide	RP32490		Aerobic Aquatic (15%) Terrestrial Field (--)	42503801 41877401
N-(3,5-dichlorophenyl)-2-(1-methylethyl)-1-ureylenecarboxamide	RP37176		Aquatic Field (--)	43718301
1-(3,5-dichlorophenyl)-5-isopropyl biuret	RP36221		Aerobic Soil (13%)	44590501

*Photolysis is probably not the mechanism for production of 3,5-DCA in this study since the dark control produced nearly equivalent amounts of 3,5-DCA.

Hydrolysis

The pH-dependent hydrolysis half life of iprodione is 131 days at a pH of 5, 4.7 days at a pH of 7, and 27 minutes at a pH of 9. These values were derived from laboratory studies (MRID 41885401) in sterile aqueous buffered solutions maintained at 25ºC. At pH 7 (neutral water), RP 30228 and RP 35606 were observed as major degradates, with the former increasing throughout the study to a maximum of 45.6% of total radioactivity measured at the conclusion of the study. Iprodione, RP 30228 and RP 35606 comprised approximately 90% of the total residues throughout the study, indicating that iprodione residues of concern are stable to hydrolysis at pH 7.

Photolysis

In an aqueous photolysis study, iprodione degraded slowly with a half life of 67 days in a pH 5 buffered solution that was irradiated continuously with a UV-filtered xenon-arc lamp (MRID 41861901). The test ran for 33 days in conditions reported to simulate Florida sunlight. Iprodione did not degrade significantly in the dark control. No major degradates (≥10% of the applied) were observed in this study.

In a soil photolysis study, iprodione degraded at a somewhat higher rate under irradiated conditions than in the dark control in a soil photolysis study (MRID 42897101). On irradiated soils, iprodione degraded with an observed DT_{50} of 7-14 days in sandy loam soil that was irradiated with a xenon-arc lamp for 8.8 hours/day for 30 days; whereas, in the dark controls, iprodione degraded with an observed DT_{50} of 14-21 days. Registrant-calculated half lives, using a first-order degradation model, were 4.64 days for the irradiated sample and 5.15 days for the dark control, thus degradation by irradiation is minimal. The major degradate observed in the irradiated soil was RP32596 [3,5-DCA] with a maximum of 28% of the applied at 14 days; while the dark control produced 37% of 3,5-DCA. Other degradates include a mixture of RP25040 and LS720942 with a maximum of 13.75% of the applied at day 7 (3% in the dark control), and RP30228 with a maximum of 7.72% immediately post treatment (11% in the dark control).

Microbial degradation (metabolism)

In an aerobic soil metabolism study (MRID 43091002) conducted in a sandy loam soil that was incubated in the dark at 25°C and 75% of 0.33 bar moisture for 276 days, unextracted and uncharacterized residues accounted for 75.8 to 86.9% of the applied ^{14}C at 181-276 days (last test interval). Thus, it is difficult to estimate actual degradation rates. The half life could be higher than 300 days if all the unidentified unextracted material were iprodione. The DT_{50} of the extracted iprodione was 14-30 days. The following degradates were observed: RP30228, with a maximum of 6.92% of the applied at 14 days; RP32596 (3,5-DCA), with a maximum of 9.02% of the applied at 30 days; and RP25040, with a maximum of 9.47% of the applied at 30 days. Volatile residues totaled 5.27% of the applied at 276 days (of which 5.23% was CO_2). Note: the soil used was the same soil used in the soil photolysis study (i.e., MRID 42897101). In a shorter 100-day aerobic soil metabolism study (MRID 44590501), iprodione degraded with a half-life between 23.9 and 100 days. The shorter half life was based on the regression of extractable iprodione only. The longer half life was based on the observation that at 100 days there was more than 50% unrecovered and uncharacterized material that could have been iprodione. Degradates were RP30228 (observed at a maximum of 29.5 %), RP36221 (observed at a maximum of 12.7%), and 3,5-DCA (observed at a maximum of 3.9%).

An aerobic soil metabolism study of 3,5-DCA (on two different soils) showed little evidence that 3,5-DCA appreciably degraded over a 9-month period at 25ºC (MRID 45239201). Apparent dissipation was caused by a high level of unextracted residue. Unextracted residues accounted for 66% and 81% of the applied in the two systems. The only residues that were distinguishable from the parent amounted to only 4 to 5% of the applied ^{14}C.

In an aerobic aquatic metabolism study, iprodione degraded with an observed DT_{50} of 3-7 days in a flooded silt loam sediment system incubated in the dark (MRID 41927601 and 42503801). However, the pH of the system was 8.5, which is a level at which hydrolysis is a major mechanism of degradation. In the pH range between 7 and 9, iprodione degrades with a half life between 27 minutes and 4.7 days, as shown in a separate hydrolysis study (MRID 41885401). Thus hydrolysis is likely the means of degradation in these studies rather than metabolism. The major degradates were RP30228, with a maximum of 64.6% of the applied at 14 days, RP32490, with 14.6% of the applied at 2 days, and 3,5-DCA with a maximum of 10% observed at the conclusion of the study (day 30), indicating that the duration of the study was not necessarily of sufficient duration to capture the full formation and decline of 3,5-DCA.

In an anaerobic aquatic metabolism study, iprodione degraded with an observed DT_{50} of 7-14 days in anaerobic (flooded plus nitrogen atmosphere) silt loam sediment that was incubated in the dark at 25°C (MRID 41755801). The pH of the water was 7.4, which is a level at which hydrolysis is likely the most significant degradation mechanism. A sterile control showed that iprodione degrades at about the same rate under sterile conditions, but RP-30228 did not dissipate (accounting for about 90% of applied after 1 year); whereas in the unsterilized test, it accounted for only about 10% after 1 year. Thus degradation of the parent does not appear to be microbially mediated, but degradation of RP-30228 does appear to be microbially mediated. The major degradates were RP30228 with a maximum of 70.7% of the applied at 14 days post-treatment; RP32490 with a maximum of 8.4% of the applied at 30 days. CO_2 accounted for 5.5-6.3% of the applied at 365 days. Organic volatiles were ≤0.6%, and unextracted residues were 16.7-20.0% of the applied.

Volatilization

Iprodione is not particularly volatile as indicated by the approximated Henry's Law constant (derived from vapor pressure, solubility, and molecular weight) of 2.7×10^{-9} atm-m^3/mol. Thus, long-range transport is not a concern. The Agency has not received any direct measurements of volatility information for 3,5-DCA. In the absence of such data, the Agency used EPISuite™, which estimated that the Henry's Law constant is much higher than for the parent (around 10^{-6} atm-m^3/mol). This value would imply that 3,5-DCA should be more volatile than the parent.

Sorption

Batch sorption tests (MRID 43349202) for iprodione in four soils are summarized in **Table 8**. Iprodione isotherms for these four soils are reasonably linear, with Freundlich exponents from 0.85 to 1.2. The mean of the organic carbon partitioning coefficients is 426 ml/g OC, which is classified as moderately mobile by the FAO mobility classification scheme (USEPA, 2006). K_F values for iprodione correlated with soil organic matter content (R^2 = 0.99), indicating that Koc is a representative measure of the soil partitioning of iprodione.

Table 8. Sorption Parameters for Iprodione[4].

Soil	Fraction of Organic Carbon (foc)	Freundlich Coefficient K_F [1, 2]	Freundlich Exponent 1/N [(1)]	K_{oc} (ml/gnOC) [3]
Loam	0.085	43.1	0.908	507
Sandy loam	0.011	2.45	0.905	223
Loamy sand	0.005	2.16	0.858	431
Clay	0.012	6.52	1.204	543

1 Freundlich Isotherm $S= K_F C^N$

2 K_F has units of [mg/kg][L/mg]^N,

3 K_{oc} value is based on the sorption coefficient (S/C, where S is sorbed concentration and C is aqueous concentration) that occurs at an aqueous concentration of 1 mg/L, which has a numerical value that is equivalent to K_F/f_{oc}.

4 These values were calculated by the registrant using the amount of decanted volume of water as the amount of water in contact with the soil, as opposed to the correct way of performing this calculation which would have been to use the total volume of water. An assessment of this error showed that the volume of water would have been underestimated by about 10% (see MRID 43349202 Table A11.3). This type of error would most significantly affect the lower K_d estimates; whereas higher K_d values would be less affected. For the cases reported in this table the sorption coefficient error should be less than 20%. One value reported by the registrant had a K_d of 0.06 and the error associated with this would be so great as to make its value meaningless and thus this value was excluded from the analysis and this table.

Batch sorption tests (MRIDs 41888904 and 45114101) for 3,5-DCA in several soils are summarized in **Table 9.** Isotherms of 3,5-DCA for these soils are nonlinear, with Freundlich exponents of approximately 0.7. This means that the sorption affinity increases as concentrations decrease and that 3,5-DCA will become less mobile as concentrations decrease. According to standard EFED practice, this chemical is classifieds as moderately mobile (USEPA, 2006), with an average K_{oc} of 610 ml/$g_{organic\ carbon}$. K_F values for 3.5-DCA are correlated with soil organic matter content (R^2 = 0.72), indicating that Koc is a representative measure of the soil partitioning of 3.5-DCA.

Table 9. Batch Sorption Results for 3,5-DCA.

Soil	Fraction of Organic Carbon (foc)	Freundlich Coefficient [(1,2)] (K_F)	FreundlichExponent[(1,2)] (1/N)	K_{oc}[(3)] (ml/g OC)	MRID
Sand	0.00116	0.576	0.74	496	41888904
Sandy loam	0.00522	1.86	0.82	356	41888904
Sandy loam	0.003422	1.75	0.68	593	45114101
Loamy sand	0.01189	7.17	0.634	626	45114101
Silt loam	0.026042	10.98	0.692	380	45114101
Loam	0.00638	2.60	0.79	408	41888904
Clay loam	0.01102	10.0	0.76	908	41888904
Clay	0.010962	9.17	0.743	932	45114101
Pond sediment	0.006264	4.635	0.646	788	45114101

1 Freundlich Isotherm $S = K_F C^{1/N}$
2 K_F has units of $[mg/kg][L/mg]^{1/N}$,
3 K_{oc} value is based on the sorption coefficient (S/C, where S is sorbed concentration and C is aqueous concentration) that occurs at an aqueous concentration of 1 mg/L, which has a numerical value that is equivalent to K_F/f_{oc}.

Bioaccumulation

In a bioconcentration study with bluegill sunfish, iprodione residues concentrated in fish tissues at a factor of 72X for whole fish. After a 14-day depuration period, total radioactive residues declined 99% (from maximum). Several iprodione degradates were reported in fish tissue, including RP25040, RP30228, RP32490and RP36119 (MRID 43091001). The octanol-water partition coefficient (Log Kow = 3.10) along with the submitted BCF studies indicate that iprodione is not likely to bioaccumulate significantly in aquatic ecosystems.

Field Dissipation Studies

Two terrestrial field dissipation studies are available (both described in MRID 41877401). Neither study monitored for the degradate 3,5-DCA. The two studies were conducted in California and North Carolina and are summarized below.

In a study conducted in San Juan Bautista, California, iprodione was applied 8 times to carrots at 1 lb ai/A/application. Iprodione dissipated with an observed DT_{50} of 7 days in the 0-15 cm soil layer of a silt loam soil (pH 7.9-8.0). The degradates RP30228 and RP32490 were recovered from the 0-15 and the 15-30 cm soil depths. Iprodione and its degradates were not detected below the 30-cm soil level. RP30228 was a maximum average of 0.47 ppm at 28 days after treatment, declining only to 0.15 ppm at 538 days. RP32490 was observed at relatively low levels (≤0.09 ppm) in the field. Field spike recoveries of iprodione at this site were 66 to 86%.

In a study conducted in North Carolina, iprodione was applied 8 times to carrots at 1 lb ai/A/application. The observed DT_{50} was less than 3 days in the 0-15 cm soil depth of a loamy sand soil (soil pH of 6.2 – 6.8). RP30228 and RP32490 were observed only in the 0-15 cm soil depth. No residues of these degradates or iprodione were detected below 15 cm. The concentrations of RP30228 were lower (ranging from 0.01 to 0.08 ppm until 492 days). Recoveries of iprodione field spikes at this site were 66 to 86%.

In aquatic field dissipation studies (MRID 43718301), iprodione was applied twice to flooded rice paddies at 0.5 lb/acre at a 15-day interval at two site—one in Waller County TX, and one in Washington County, MS. Iprodione was applied to the rice foliage at both sites (55% canopy coverage at TX, 85% at MS). The two sites were flooded for 1 month. The pH of the flood waters at both sites were in the range for which iprodione readily degrades by hydrolysis. Flood water dissipation half lives were 3.7 days in Texas and 2.9 days in Mississippi; soil half lives however were on the order of months. Maximum concentrations observed in both studies were around 500 ppb. Storage sample recoveries for 3,5-DCA were only 18%, and thus this study is not suitable for characterizing the formation or persistence of 3,5-DCA. The major degradates observed at both sites were RP 30228 and RP 37176.

2.4.2 Mechanism of Action

Iprodione is a member of the carboximide fungicides used to control various blights and rots caused by fungal pathogens. Iprodione causes oxidative damage to fungal cells as well as to mammalian and fish cells through the production of free oxygen radicals. The chemical has been demonstrated to bind to the aryl hydrocarbon receptor (AhR) and induce the cytochrome P_{450} system *in vitro*.[2,3,4] Additionally, iprodione is structurally related to the dichloroanilines as is the degradate 3,5-dichloroaniline (3,5-DCA). Based on information contained in the Assessment Tools for the Evaluation of Risk (ASTER) database[5], compounds such as DCA are believed to act through polar narcosis. The acute mode of toxic action for these types of compounds is generally attributed to narcosis (the toxicologically induced and reversible stages of neural disruption). The narcosis syndrome elicited by these chemicals is distinct from the syndrome elicited by compounds thought to act via nonpolar narcosis. Polar narcotics are typically more toxic than what would be predicted from the nonpolar narcotic Quantitative Structure Activity Relationship (QSAR).

2.4.3 Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current labels for iprodione represent the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs. At this time, there are 42 registered labels for iprodione that are relevant to uses throughout the United States; 4 of these are for technical formulations and 38 are for formulated products. While technical products, which contain iprodione of high purity, are not used directly in the environment, they are used to make formulated products, which can be applied in specific areas to control fungal blights and rusts. The formulated product labels legally limit iprodione's potential use to only those sites that are specified on the labels. In addition to the 38 nationally registered formulated product labels, there are currently 7 special local needs labels that apply to use of iprodione use in California. The nationally registered formulated products and special local needs registrations that are included in defining the federal action for this assessment are provided in Appendix A. The use disclosure memo for iprodione is provided in Appendix B.

Iprodione is currently registered for use in California for 37 different agricultural crops. Agricultural uses include almonds, stone fruits, beans, caneberries, bushberries, canola, cole crops, carrots, cotton, crucifer, garlic, grapes, lettuce, onions, peanuts, potatoes, radish, rutabaga, strawberries and turnip greens. Applications to agricultural uses can be made via several

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[2] Ferraris, M., A. Flora, C. Chiesara, D. Fornasari, H. Lucchetti, L. Marabina, S. Frigerio and S. Radice. 2005. Molecular mechanism of the aryl hydrocarbon receptor activated by the fungicide iprodione in rainbow trout (*Oncorhynchus mykiss*) hepatocytes. Aquatic Toxicology 72: 209 – 220.

[3] Radice, S., M. Ferraris, L. Marabini, S. Grande, E. Chiesara. 2001. Effect of iprodione, a dicarboximide fungicide, on primary cultured rainbow trout (*Oncorhynchus mykiss*) hepatocytes. Aquatic Toxicology 54: 51 – 58.

[4] Long, M. P. Laier, A. M. Vinggaard, H. R. Anderson, J. Lynggaard, E. C. Bonefeld-Jørgensen. 2003. Effects of currently used pesticides in the AhR CALUX assay: comparison between the human TV101L and the rate H4IIE cell line. Toxicology 194: 77 – 93.

[5] ASTER (Assessment Tools for the Evaluation of Risk) http://cfistage.rtpnc.epa.gov/aster/

different application methods, including ground spray, spray by aircraft, chemigation, soil in furrow treatment, dip treatment and seed treatment. The maximum single application rate varies by the specific agricultural use and ranges 0.27-1.37 lbs a.i./A. Specific application rates (maximums), numbers of applications per season, application intervals, timing of applications and application methods for the agricultural uses are provided in **Table 10**.

It should be noted that some formulated product labels for iprodione allow for the use on ginseng in California; however, based on analysis of National Agricultural Statistics Service (NASS) data, ginseng is not grown in California and is therefore, not relevant to this assessment.

Table 10. Agricultural uses of iprodione that are relevant to CA.

Use(s)	Max application rate (lbs a.i./A)	# applications /season	Application interval (days)	Initial application timing	Application method
almonds	0.5	4	again at full bloom, petal fall, and several weeks after petal fall	pink bud	ground spray, chemigation, air spray
beans	1	2	5	bloom	ground spray, chemigation, air spray
berries[1]	1	4	14	bloom	ground spray, chemigation, air spray
canola	1	5	up to day of harvest	2-4 leaf stage	ground spray, chemigation, air spray
carrots	1	4	7	foliar	ground spray, chemigation, air spray
cole crops[2]	1	5	up to day of harvest	2-4 leaf stage	ground spray, chemigation, air spray
cotton	0.2719	1*	not applicable	at planting	soil in-furrow treatment
crucifer	1	5	up to day of harvest	2-4 leaf stage	ground spray, chemigation, air spray
garlic	2	1	not applicable	at planting	soil in-furrow treatment
grapes	1	4	again at bunch closing, fruit ripening, prior to fruit harvest	bloom	ground spray, chemigation, air spray
lettuce	1	4	10	3 leaf stage	ground spray, chemigation
lettuce	1	3	10	3 leaf stage	air spray
onions	0.75	5	14	foliar	ground spray, chemigation, air spray
peanuts	1	3	14	foliar	ground spray, chemigation
potatoes	1	4	10	foliar	ground spray, chemigation, air spray
radishes	1	5	not stated	bloom	ground spray, chemigation, air spray
rutabagas	1	5	not stated	bloom	ground spray, chemigation, air spray
Stone fruit[3]	1.3725	2	again at full bloom or petal fall	bud	air and ground spray
strawberries	1	1	not applicable	bloom	ground spray, air spray, dip treatment
Turnip greens	1	5	up to day of harvest	2-4 leaf stage	ground spray, chemigation, air spray

*assumed based on application method

[1] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries

[2] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi

[3] Specifically: apricots, cherries, nectarines, peaches, plums, prunes

Specific crops where iprodione is used as a seed treatment are listed in **Table 11**, along with the application rate for seeds (8.333 lbs a.i./cwt). **Table 11** also provides seeding rates obtained from Extension offices for the crops to which iprodione can be applied as a seed treatment. When the seeding rates are taken into account with the application rate of iprodione on seeds, single application rates range 0.125-1.5 lbs a.i./A, which is generally lower than when the pesticide is applied directly to a field via ground spray, chemigation or air spray.

Table 11. Seed treatments of iprodione that are relevant to CA.

Uses	lb a.i./cwt	Seeding Rate (cwt/A)	Lbs a.i./A
broccoli	8.333	0.015[1]	0.125
Brussels sprouts		0.015[2]	0.125
cabbage		0.015[3]	0.125
canola		0.08[4]	0.667
carrot		0.04[5]	0.333
cauliflower		0.015[3]	0.125
kale		0.015[3]	0.125
kohlrabi		0.05[3]	0.417
radish		0.18[6]	1.5
rutabaga		0.02[6]	0.167
turnip greens		0.02[3]	0.167

[1]http://ucanr.org/freepubs/docs/7211.pdf
[2]Assume same rate as broccoli, cabbage, cauliflower and kale
[3] http://aggie-horticulture.tamu.edu/extension/vegetable/cropguides/
[4]From T-REX
[5]http://www.extension.umn.edu/Distribution/horticulture/DG7196.html#Seeding
[6]http://ohioline.osu.edu/b672/pdf/Radishes.pdf

In addition, iprodione is registered for several non-agricultural uses, including conifers, turf grass (golf courses, sod farms and commercial industrial lawns) and ornamentals. Based on the labels, a maximum single application rate of 22.44 lbs a.i./A may be made to ornamentals via drench. Use of iprodione in residential areas (*e.g.*, turf and ornamentals) is prohibited. **Table 12** summarizes non-agricultural uses of iprodione.

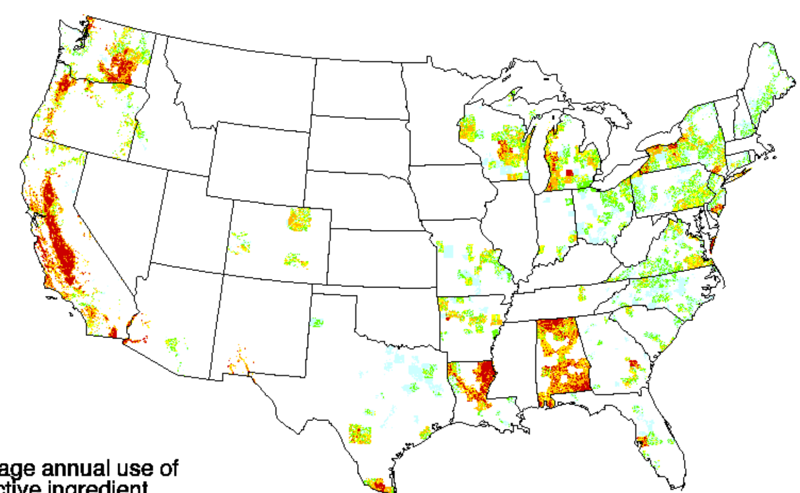
Table 12. Non-agricultural uses of iprodione that are relevant to CA.

Use	Max application rate (lbs a.i./A)	# applications /season	Application interval (days)	Initial application timing	Application method
conifers	1.25	4	7	foliar	sprayer, chemigation, drip
ornamentals	2.805	no limit defined	10	foliar	ground spray, chemigation
ornamentals	22.44	no limit defined	14	after transplant	drench
turf[1]	8.16	2*	14	foliar	ground spray
turf[2]	5.44	4**	14	foliar	ground spray

*Plus a 3rd application of 5.48 lbs a.i./A
**Plus a 5th application of 2.04 lbs a.i./A
[1]golf course - greens, tees and aprons
[2] golf course, sod farm, commercial industrial lawns

It should be noted that iprodione labels indicate that applications to areas adjacent to water bodies (including lakes, reservoirs, rivers, streams, marshes, natural ponds, commercial fish ponds and estuaries) should only be made where a 25 foot vegetated buffer strip exists.

As of 2002, over 460,000 lbs of iprodione were applied annually to agricultural crops in the United States; the highest poundage (133,254 lbs) was applied to cotton. Almonds (116,979 lbs), potatoes (57,463 lbs) and lettuce (54,408 lbs) represented the uses with next highest total pounds of iprodione applied. In total, these 4 uses represented over 70% of the estimated annual agricultural uses of iprodione in the continental US (**Figure 2**). The map in **Figure 2** was downloaded from a U.S. Geological Survey (USGS), National Water Quality Assessment Program (NAWQA) website (http://water.usgs.gov/nawqa/pnsp/usage/maps/compound_listing.php?year=02). It should be noted that this map does not account for non-agricultural uses of iprodione, such as turf and ornamentals.



Crops	Total pounds applied	Percent national use
cotton	133254	27.04
almonds	116979	23.74
potatoes	57463	11.66
lettuce	54408	11.04
dry onions	24562	4.98
grapes	19097	3.87
peaches	19084	3.87
carrots	18930	3.84
cherries	9973	2.02
nectarines	7688	1.56

Figure 2. Average Annual Iprodione Use in continental US in Total Pounds per County in 2002.

Iprodione use information from the California Department of Pesticide Regulation (CDPR 2007a) is depicted in **Figure 3** and shows total iprodione use in California from from 1997 to 2007 averaged 342,667 lbs (standard error: ±30,746 lbs) based on California Pesticide Use Reports[6] (PUR). Compared to the peak use of 572,389 lbs reported for 1998, iprodione use in California declined by roughly 47% in 2001 and has been roughly level since that time. Based on PUR data, total acreage treated in 1998 was 1,348,382 acres; however, acreage treated had declined to 501,033 acres in 2001 representing a 63% decline.

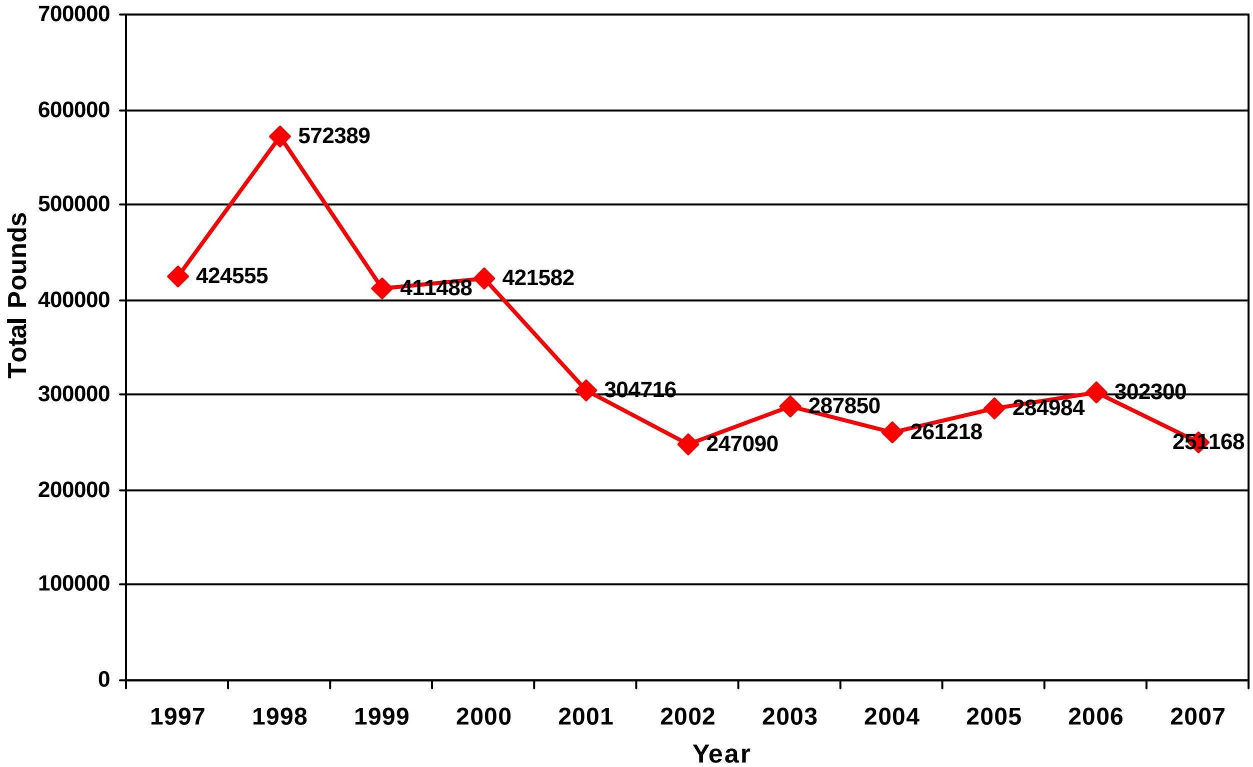


Figure 3. Total annual use of iprodione in California between 1996 - 2007. California Department of Pesticide Regulation (2007).

[6] California Department of Pesticide Regulation. 2007. Summary of Pesticide Use Report Date 2007 Indexed by Chemical. http://www.cdpr.ca.gov/docs/pur/pur07rep/chmrpt07.pdf

Pesticide use information from CDPR (2007a) includes county-level data for various iprodione uses from 1999-2006. The majority (85%) of this use occurred in the following counties: Kern, Monterey, Fresno, Stanislaus, Merced, Madera, Tulare, San Joaquin, Santa Barbara, Ventura, Kings and Los Angeles (**Table 13**). Past uses of iprodione include the majority of the uses identified in **Table 10** (note that all uses reported in PUR are not included in **Table 14**, *e.g.*, blueberry, raspberry, beans). The average lbs of iprodione applied per year in California was highest on almonds (39% of total use) and lettuce (16% of total use) (**Table 14**). 'Landscape maintenance' is likely to be the turf use.

Table 13. Average annual lbs of iprodione applied per county in CA, based on California Department of Pesticide Registration (CDPR) Pesticide Use Reporting (PUR) Data from 1999 to 2006. This table includes counties with an average >1000 lbs iprodione applied per year.

County	Average lbs/year	% of total
KERN	53,976	17%
MONTEREY	49,068	16%
FRESNO	40,977	13%
STANISLAUS	26,233	8%
MERCED	18,223	6%
MADERA	18,017	6%
TULARE	15,611	5%
SAN JOAQUIN	14,730	5%
SANTA BARBARA	12,401	4%
VENTURA	9,070	3%
KINGS	5,311	2%
LOS ANGELES	5,000	2%
BUTTE	4,296	1%
SAN LUIS OBISPO	4,287	1%
SAN DIEGO	4,113	1%
IMPERIAL	4,061	1%
ORANGE	3,986	1%
COLUSA	2,885	1%
GLENN	2,863	1%
SANTA CRUZ	2,614	1%
SUTTER	2,183	1%
YUBA	1,592	1%
SANTA CLARA	1,257	<1%
SAN BENITO	1,255	<1%
RIVERSIDE	1,186	<1%
SONOMA	1,155	<1%
YOLO	1,147	<1%

Table 14. Average annual lbs of iprodione applied per use in CA, based on California Department of Pesticide Registration (CDPR) Pesticide Use Reporting (PUR) Data from 1999 to 2006. This table includes uses with an average >1000 lbs iprodione applied in CA per year.

Use	Average lbs/year	% of total
almond	123,756	39%
lettuce	50,844	16%
carrot	21,785	7%
grape	20,907	7%
peach	16,792	5%
strawberry	14,647	5%
landscape maintenance	11,494	4%
cherry	8,700	3%
nectarine	8,637	3%
outdoor ornamental	8,447	3%
onion	7,125	2%
apricot	5,196	2%
plum	4,042	1%
greenhouse	3,283	1%
prune	3,038	1%
potato	1,512	<1%
broccoli	1,016	<1%

The uses considered in this risk assessment represent all currently registered uses in California according to a review of all current labels. No other uses are relevant to this assessment. Any reported use not represented on current labels, such as may be seen in the CDPR PUR database, represent either historic uses that have been cancelled, misreported uses, or misuse. Historical uses, misreported uses, and misuse are not considered part of the federal action and, therefore, are not considered in this assessment.

Analysis of the mass of iprodione applied with consideration of the application area indicates that applications have been made at or above the maximum application rates identified in **Table 10.** In situations where the use data indicate higher than maximum label application rates, the discrepancy is considered to be most likely due to misreporting.

2.5 Assessed Species

The CRLF was federally listed as a threatened species by USFWS effective June 24, 1996 (USFWS 1996). It is one of two subspecies of the red-legged frog and is the largest native frog in the western United States (USFWS 2002). A brief summary of information regarding CRLF distribution, reproduction, diet, and habitat requirements is provided in Sections 2.5.1 through 2.5.4, respectively. Further information on the status, distribution, and life history of and specific threats to the CRLF is provided in **Attachment I**.

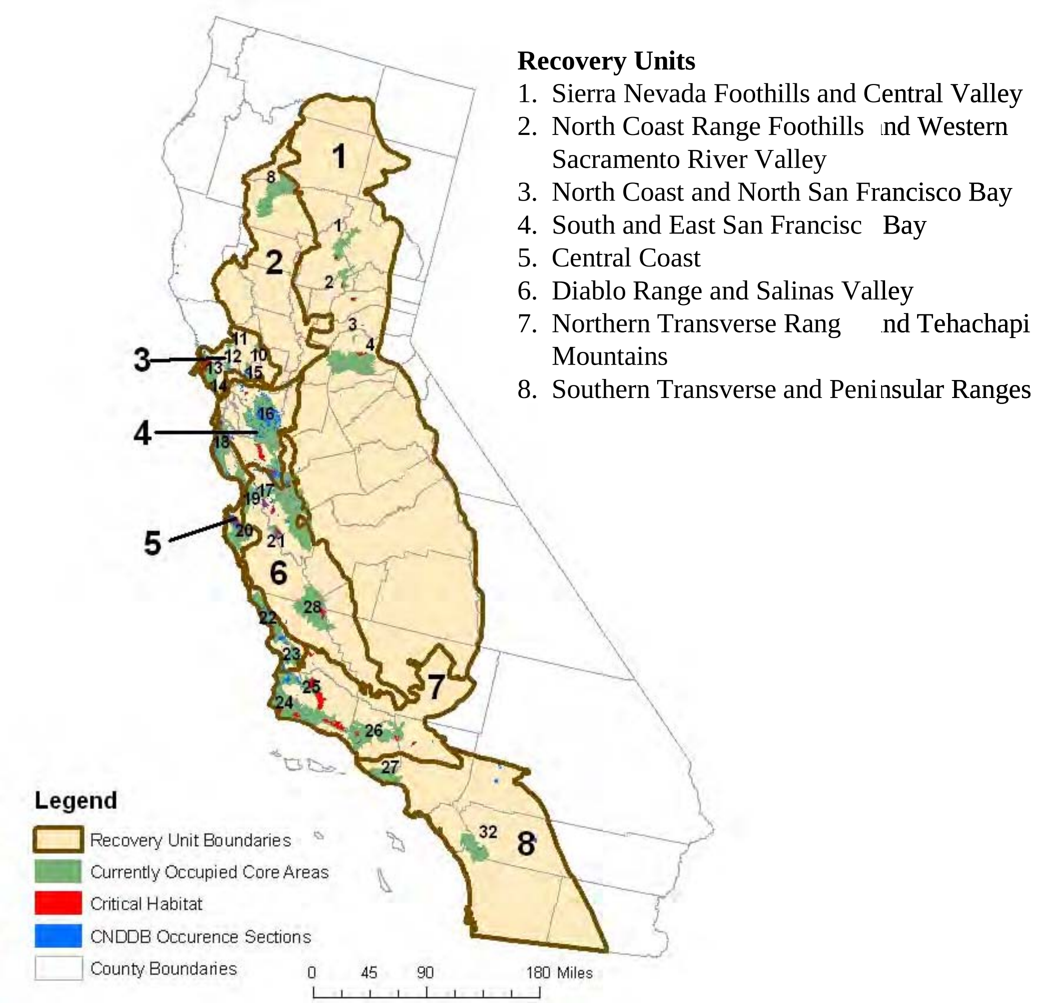
Final critical habitat for the CRLF was designated by USFWS on April 13, 2006 (USFWS 2006; 71 FR 19244-19346). Further information on designated critical habitat for the CRLF is provided in Section 2.6.

2.5.1 Distribution

The CRLF is endemic to California and Baja California (Mexico) and historically inhabited 46 counties in California including the Central Valley and both coastal and interior mountain ranges (USFWS 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (USFWS 1996). The species has an elevational range of near sea level to 1,500 meters (5,200 feet) (Jennings and Hayes 1994); however, nearly all of the known CRLF populations have been documented below 1,050 meters (3,500 feet) (USFWS 2002).

Populations currently exist along the northern California coast, northern Transverse Ranges (USFWS 2002), foothills of the Sierra Nevada (5-6 populations), and in southern California south of Santa Barbara (two populations) (Fellers 2005a). Relatively larger numbers of CRLFs are located between Marin and Santa Barbara Counties (Jennings and Hayes 1994). A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS 1996). Occupied drainages or watersheds include all bodies of water that support CRLFs (i.e., streams, creeks, tributaries, associated natural and artificial ponds, and adjacent drainages), and habitats through which CRLFs can move (i.e., riparian vegetation, uplands) (USFWS 2002).

The distribution of CRLFs within California is addressed in this assessment using four categories of location including recovery units, core areas, designated critical habitat, and known occurrences of the CRLF reported in the California Natural Diversity Database (CNDDB) that are not included within core areas and/or designated critical habitat (**Figure 4**). Recovery units, core areas, and other known occurrences of the CRLF from the CNDDB are described in further detail in Attachment I, and designated critical habitat is addressed in Section 2.6. Recovery units are large areas defined at the watershed level that have similar conservation needs and management strategies. The recovery unit is primarily an administrative designation, and land area within the recovery unit boundary is not exclusively CRLF habitat. Core areas are smaller areas within the recovery units that comprise portions of the species' historic and current range and have been determined by USFWS to be important in the preservation of the species. Designated critical habitat is generally contained within the core areas, although a number of critical habitat units are outside the boundaries of core areas, but within the boundaries of the recovery units. Additional information on CRLF occurrences from the CNDDB is used to cover the current range of the species not included in core areas and/or designated critical habitat, but within the recovery units.



Core Areas

1. Feather River
2. Yuba River- S. Fork Feather River
3. Traverse Creek/ Middle Fork/ American R. Rubicon
4. Cosumnes River
5. South Fork Calaveras River*
6. Tuolumne River*
7. Piney Creek*
8. Cottonwood Creek
9. Putah Creek – Cache Creek*
10. Lake Berryessa Tributaries
11. Upper Sonoma Creek
12. Petaluma Creek – Sonoma Creek
13. Pt. Reyes Peninsula
14. Belvedere Lagoon
15. Jameson Canyon – Lower Napa River
16. East San Francisco Bay
17. Santa Clara Valley
18. South San Francisco Bay
19. Watsonville Slough-Elkhorn Slough
20. Carmel River – Santa Lucia
21. Gablan Range
22. Estero Bay
23. Arroyo Grange River
24. Santa Maria River – Santa Ynez River
25. Sisquoc River
26. Ventura River – Santa Clara River
27. Santa Monica Bay – Venura Coastal Streams
28. Estrella River
29. San Gabriel Mountain*
30. Forks of the Mojave*
31. Santa Ana Mountain*
32. Santa Rosa Plateau
33. San Luis Ray*
34. Sweetwater*
35. Laguna Mountain*

* Core areas that were historically occupied by the California red-legged frog are not included in the map

Figure 4. Recovery Unit, Core Area, Critical Habitat, and Occurrence Designations for CRLF.

Other Known Occurrences from the CNDBB

The CNDDB provides location and natural history information on species found in California. The CNDDB serves as a repository for historical and current species location sightings. Information regarding known occurrences of CRLFs outside of the currently occupied core areas and designated critical habitat is considered in defining the current range of the CRLF. See: http://www.dfg.ca.gov/bdb/html/cnddb_info.html for additional information on the CNDDB.

2.5.2 Reproduction

CRLFs breed primarily in ponds; however, they may also breed in quiescent streams, marshes, and lagoons (Fellers 2005a). According to the Recovery Plan (USFWS 2002), CRLFs breed from November through late April. Peaks in spawning activity vary geographically; Fellers (2005b) reports peak spawning as early as January in parts of coastal central California. Eggs are fertilized as they are being laid. Egg masses are typically attached to emergent vegetation, such as bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.) or roots and twigs, and float on or near the surface of the water (Hayes and Miyamoto 1984). Egg masses contain approximately 2000 to 6000 eggs ranging in size between 2 and 2.8 mm (Jennings and Hayes 1994). Embryos hatch 10 to 14 days after fertilization (Fellers 2005a) depending on water temperature. Egg predation is reported to be infrequent and most mortality is associated with the larval stage (particularly through predation by fish); however, predation on eggs by newts has also been reported (Rathburn 1998). Tadpoles require 11 to 28 weeks to metamorphose into juveniles (terrestrial-phase), typically between May and September (Jennings and Hayes 1994, USFWS 2002); tadpoles have been observed to over-winter (delay metamorphosis until the following year) (Fellers 2005b, USFWS 2002). Males reach sexual maturity at 2 years, and females reach sexual maturity at 3 years of age; adults have been reported to live 8 to 10 years (USFWS 2002). **Figure 5** depicts CRLF annual reproductive timing.

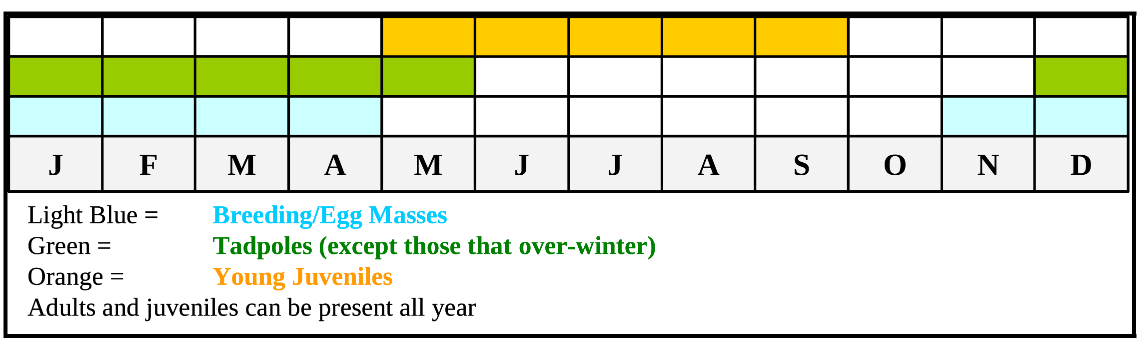


Figure 5. CRLF Reproductive Events by Month.

2.5.3 Diet

Although the diet of CRLF aquatic-phase larvae (tadpoles) has not been studied specifically, it is assumed that their diet is similar to that of other frog species, with the aquatic phase feeding exclusively in water and consuming diatoms, algae, and detritus (USFWS 2002). Tadpoles filter and entrap suspended algae (Seale and Beckvar, 1980) via mouthparts designed for effective grazing of periphyton (Wassersug, 1984, Kupferberg *et al.*; 1994; Kupferberg, 1997; Altig and McDiarmid, 1999).

Juvenile and adult CRLFs forage in aquatic and terrestrial habitats, and their diet differs greatly from that of larvae. The main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic and terrestrial invertebrates found along the shoreline and on the water surface. Hayes and Tennant (1985) report, based on a study examining the gut content of 35 juvenile and adult CRLFs, that the species feeds on as many as 42 different invertebrate taxa, including Arachnida, Amphipoda, Isopoda, Insecta, and Mollusca. The most commonly observed prey species were larval alderflies (*Sialis* cf. *californica*), pillbugs (*Armadilliadrium vulgare*), and water striders (*Gerris* sp). The preferred prey species, however, was the sowbug (Hayes and Tennant, 1985). This study suggests that CRLFs forage primarily above water, although the authors note other data reporting that adults also feed under water, are cannibalistic, and consume fish. For larger CRLFs, over 50% of the prey mass may consists of vertebrates such as mice, frogs, and fish, although aquatic and terrestrial invertebrates were the most numerous food items (Hayes and Tennant 1985). For adults, feeding activity takes place primarily at night; for juveniles feeding occurs during the day and at night (Hayes and Tennant 1985).

2.5.4 Habitat

CRLFs require aquatic habitat for breeding, but also use other habitat types including riparian and upland areas throughout their life cycle. CRLF use of their environment varies; they may complete their entire life cycle in a particular habitat or they may utilize multiple habitat types. Overall, populations are most likely to exist where multiple breeding areas are embedded within varying habitats used for dispersal (USFWS 2002). Generally, CRLFs utilize habitat with perennial or near-perennial water (Jennings et al. 1997). Dense vegetation close to water, shading, and water of moderate depth are habitat features that appear especially important for CRLF (Hayes and Jennings 1988).

Breeding sites include streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds (land depressions between fault zones that have filled with water), dune ponds, and lagoons. Breeding adults have been found near deep (0.7 m) still or slow moving water surrounded by dense vegetation (USFWS 2002); however, the largest number of tadpoles have been found in shallower pools (0.26 – 0.5 m) (Reis, 1999). Data indicate that CRLFs do not frequently inhabit vernal pools, as conditions in these habitats generally are not suitable (Hayes and Jennings 1988).

CRLFs also frequently breed in artificial impoundments such as stock ponds, although additional research is needed to identify habitat requirements within artificial ponds (USFWS 2002). Adult CRLFs use dense, shrubby, or emergent vegetation closely associated with deep-water pools bordered with cattails and dense stands of overhanging vegetation (http://www.fws.gov/endangered/features/rl_frog/rlfrog.html#where).

In general, dispersal and habitat use depends on climatic conditions, habitat suitability, and life stage. Adults rely on riparian vegetation for resting, feeding, and dispersal. The foraging quality of the riparian habitat depends on moisture, composition of the plant community, and presence of pools and backwater aquatic areas for breeding. CRLFs can be found living within streams at distances up to 3 km (2 miles) from their breeding site and have been found up to 30 m (100 feet) from water in dense riparian vegetation for up to 77 days (USFWS 2002).

During dry periods, the CRLF is rarely found far from water, although it will sometimes disperse from its breeding habitat to forage and seek other suitable habitat under downed trees or logs, industrial debris, and agricultural features (UWFWS 2002). According to Jennings and Hayes (1994), CRLFs also use small mammal burrows and moist leaf litter as habitat. In addition, CRLFs may also use large cracks in the bottom of dried ponds as refugia; these cracks may provide moisture for individuals avoiding predation and solar exposure (Alvarez 2000).

2.6 Designated Critical Habitat

In a final rule published on April 13, 2006, 34 separate units of critical habitat were designated for the CRLF by USFWS (USFWS 2006; FR 51 19244-19346). A summary of the 34 critical habitat units relative to USFWS-designated recovery units and core areas (previously discussed in Section 2.5.1) is provided in **Attachment I**.

'Critical habitat' is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are 'essential to the conservation of the species.' All designated critical habitat for the CRLF was occupied at the time of listing. Critical habitat receives protection under Section 7 of the ESA (Section 7) through prohibition against destruction or adverse modification with regard to actions carried out, funded, or authorized by a federal Agency. Section 7 requires consultation on federal actions that are likely to result in the destruction or adverse modification of critical habitat.

To be included in a critical habitat designation, the habitat must be 'essential to the conservation of the species.' Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). PCEs include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. The designated critical habitat areas for the CRLF are considered to have the following PCEs that justify critical habitat designation:

- Breeding aquatic habitat;
- Non-breeding aquatic habitat;
- Upland habitat; and
- Dispersal habitat.

Further description of these habitat types is provided in Attachment I.

Occupied habitat may be included in the critical habitat only if essential features within the habitat may require special management or protection. Therefore, USFWS does not include areas where existing management is sufficient to conserve the species. Critical habitat is designated outside the geographic area presently occupied by the species only when a designation limited to its present range would be inadequate to ensure the conservation of the species. For the CRLF, all designated critical habitat units contain all four of the PCEs, and were occupied by the CRLF at the time of FR listing notice in April 2006. The FR notice designating critical habitat for the CRLF includes a special rule exempting routine ranching activities associated with livestock ranching from incidental take prohibitions. The purpose of this exemption is to promote the conservation of rangelands, which could be beneficial to the CRLF, and to reduce the rate of conversion to other land uses that are incompatible with CRLF conservation. Please see Attachment I for a full explanation on this special rule.

USFWS has established adverse modification standards for designated critical habitat (USFWS 2006). Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of iprodione that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. According to USFWS (2006), activities that may affect critical habitat and therefore result in adverse effects to the CRLF include, but are not limited to the following:

(1) Significant alteration of water chemistry or temperature to levels beyond the tolerances of the CRLF that result in direct or cumulative adverse effects to individuals and their life-cycles.
(2) Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.
(3) Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat that could result in elimination or reduction of habitat necessary for the growth and reproduction of the CRLF by increasing the sediment deposition to levels that would adversely affect their ability to complete their life cycles.
(4) Significant alteration of channel/pond morphology or geometry that may lead to changes to the hydrologic functioning of the stream or pond and alter the timing, duration, water flows, and levels that would degrade or eliminate the CRLF and/or its habitat. Such an effect could also lead to increased sedimentation and degradation in water quality to levels that are beyond the CRLF's tolerances.
(5) Elimination of upland foraging and/or aestivating habitat or dispersal habitat.
(6) Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.

(7) Alteration or elimination of the CRLF's food sources or prey base (also evaluated as indirect effects to the CRLF).

As previously noted in Section 2.1, the Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because iprodione is expected to directly impact living organisms within the action area, critical habitat analysis for iprodione is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes.

2.7 Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). It is recognized that the overall action area for the national registration of iprodione is likely to encompass considerable portions of the United States based on the use of iprodione on agricultural areas, forest trees and on turf . However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the CRLF and its designated critical habitat within the state of California. The Agency's approach to defining the action area under the provisions of the Overview Document (USEPA 2004) considers the results of the risk assessment process to establish boundaries for that action area with the understanding that exposures below the Agency's defined Levels of Concern (LOCs) constitute a no-effect threshold. For the purposes of this assessment, attention will be focused on the footprint of the action (*i.e.,* the area where pesticide application occurs), plus all areas where offsite transport (*i.e.,* spray drift, downstream dilution, etc.) may result in potential exposure within the state of California that exceeds the Agency's LOCs.

Deriving the geographical extent of this portion of the action area is based on consideration of the types of effects that iprodione may be expected to have on the environment, the exposure levels to iprodione that are associated with those effects, and the best available information concerning the use of iprodione and its fate and transport within the state of California. Specific measures of ecological effect for the CRLF that define the action area include any direct and indirect toxic effect to the CRLF and any potential modification of its critical habitat, including reduction in survival, growth, and fecundity as well as the full suite of sublethal effects available in the effects literature. Therefore, the action area extends to a point where environmental exposures are below any measured lethal or sublethal effect threshold for any biological entity at the whole organism, organ, tissue, and cellular level of organization. In situations where it is not possible to determine the threshold for an observed effect, the action area is not spatially limited and is assumed to be the entire state of California.

The definition of action area requires a stepwise approach that begins with an understanding of the federal action. The federal action is defined by the currently labeled uses for iprodione. An analysis of labeled uses and review of available product labels was completed. For those uses relevant to the CRLF, the analysis indicates that, for iprodione, several agricultural and non-agricultural uses are considered as part of the federal action evaluated in this assessment (**Table 15**).

Following a determination of the assessed uses, an evaluation of the potential "footprint" of iprodione use patterns (*i.e.*, the area where pesticide application occurs) is determined. This "footprint" represents the initial area of concern, based on an analysis of available land cover data for the state of California. The initial area of concern is defined as all land cover types and the stream reaches within the land cover areas that represent potential iprodione use sites. Specific uses of iprodione that are relevant to the CRLF and their associated spatial (GIS) land covers used to define the potential footprint of the use patterns is provided in **Table 15**. A map representing all the land cover types that make up the initial area of concern for iprodione is presented in **Figure 6**

Table 15. Iprodione uses and their respective GIS land covers used to depict the potential "footprint" of iprodione use patterns considered for this assessment.

GIS Land cover	Uses
Orchard/vineyard	almonds, apricots, cherries, grapes, nectarines, peaches, plums, prunes
agricultural lands	beans, blackberries, blueberries, broccoli, Brussels sprouts, bushberries, cabbage, caneberries, carrots, cauliflower, cotton, crucifer, currants, elderberries, garlic, gooseberries, huckleberries, kale, kohlrabi, lettuce, loganberry, onions, ornamentals, peanuts, potatoes, radishes, raspberries, rutabagas, strawberries, turnip (greens)
turf	Commercial/industrial lawns, turf (golf course, lawn)
non-urban forests	Forest trees (conifers)

Potential Iprodione Use - Initial Area of Concern

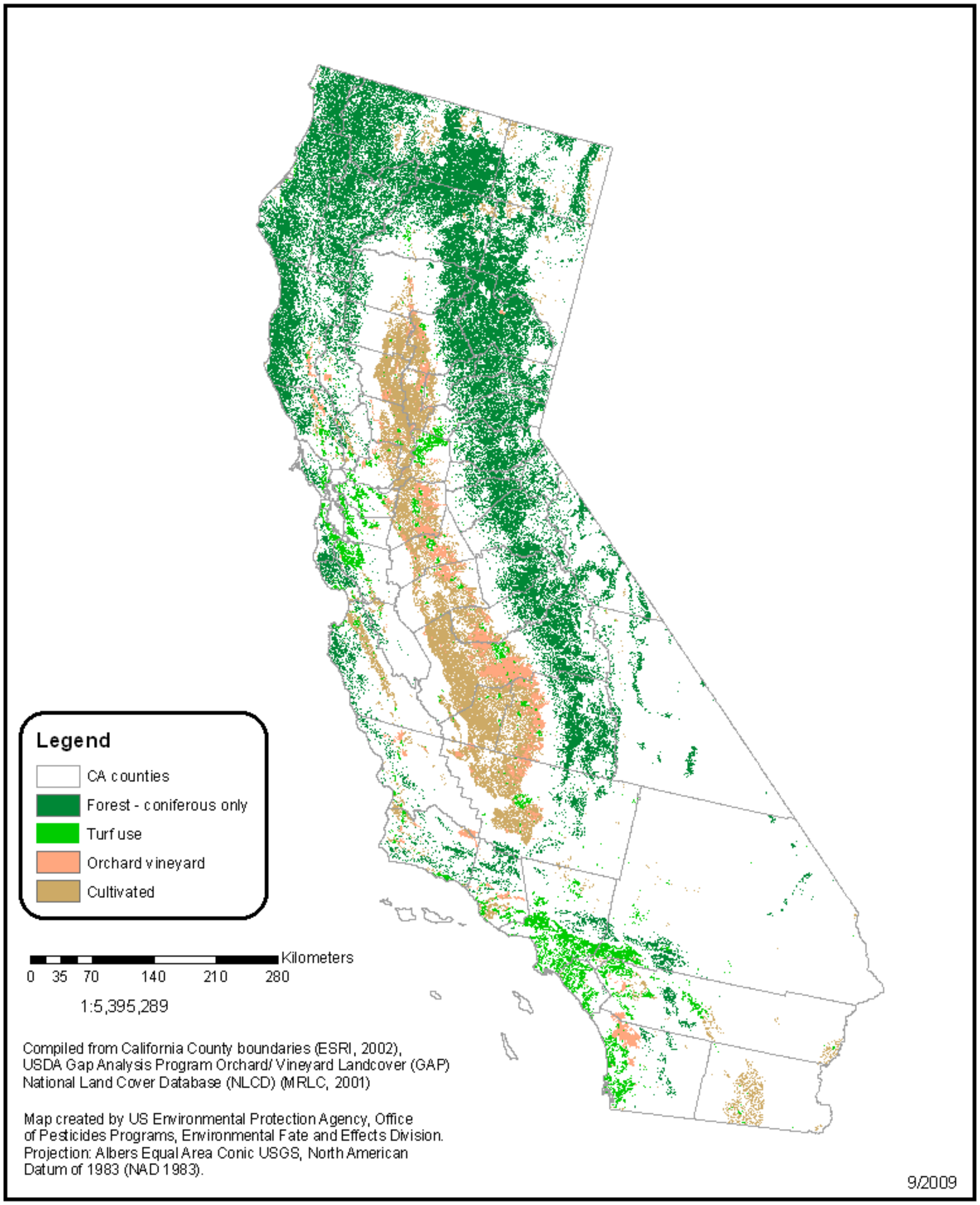


Figure 6. Initial area of concern, or "footprint" of potential use, for iprodione.

Once the initial area of concern is defined, the next step is to define the potential boundaries of the action area by determining the extent of offsite transport via spray drift and runoff where exposure of one or more taxonomic groups to the pesticide exceeds the listed species LOCs. In this assessment, transport of iprodione through runoff and spray drift is considered in deriving quantitative estimates of iprodione exposure to CRLF, its prey and its habitats. Since this screening-level risk assessment defines taxa that are predicted to be exposed through runoff and drift to iprodione at concentrations above the Agency's Levels of Concern (LOC), there is need to expand the action area to include areas that are affected indirectly by this federal action. Because iprodione is considered by the EPA as a "likely" carcinogen (see iprodione RED) and because the terminal metabolite of iprodione, 3,5-DCA was considered to have a genotoxic mode of tumor induction (based on its similarity to its structural analog *para*-chloraniline which is carcinogenic in mammals), the action area for iprodione is established as the entire state of California. Additional analysis related to the intersection of the iprodione action area and CRLF habitat used in determining the final action area is described in **Appendix C**.

2.8 Assessment Endpoints and Measures of Ecological Effect

Assessment endpoints are defined as "explicit expressions of the actual environmental value that is to be protected."[7] Selection of the assessment endpoints is based on valued entities (e.g., CRLF, organisms important in the life cycle of the CRLF, and the PCEs of its designated critical habitat), the ecosystems potentially at risk (e.g., waterbodies, riparian vegetation, and upland and dispersal habitats), the migration pathways of iprodione (*e.g*., runoff, spray drift, etc.), and the routes by which ecological receptors are exposed to iprodione (*e.g*., direct contact, *etc*.).

2.8.1 Assessment Endpoints for the CRLF

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF. Each assessment endpoint requires one or more "measures of ecological effect," defined as changes in the attributes of an assessment endpoint or changes in a surrogate entity or attribute in response to exposure to a pesticide. Specific measures of ecological effect are generally evaluated based on acute and chronic toxicity information from registrant-submitted guideline tests that are performed on a limited number of organisms. Additional ecological effects data from the open literature are also considered. It should be noted that assessment endpoints are limited to direct and indirect effects associated with survival, growth, and fecundity, and do not include the full suite of sublethal effects used to define the action area. According the Overview Document (USEPA 2004), the Agency relies on acute and chronic effects endpoints that are either direct measures of impairment of survival, growth, or fecundity or endpoints for which there is a scientifically robust, peer reviewed relationship that can quantify the impact of the measured effect endpoint on the assessment endpoints of survival, growth, and fecundity.

A complete discussion of all the toxicity data available for this risk assessment, including resulting measures of ecological effect selected for each taxonomic group of concern, is

[7] U.S. EPA (1992). *Framework for Ecological Risk Assessment.* EPA/630/R-92/001.

included in Section 4.0 of this document. A summary of the assessment endpoints and measures of ecological effect selected to characterize potential assessed direct and indirect CRLF risks associated with exposure to iprodione is provided in **Table 16**.

Table 16. Assessment Endpoints and Measures of Ecological Effects.

Assessment Endpoint	Measures of Ecological Effects[8]
Aquatic-Phase CRLF (Eggs, larvae, juveniles, and adults)[a]	
Direct Effects	
1. Survival, growth, and reproduction of CRLF	1a. Most sensitive freshwater fish, *i.e*, channel catfish (*Ictalurus punctatus*) acute LC_{50} 1b. Most sensitive freshwater fish, *i.e.*, fathead minnow (*Pimephales promelas*) NOAEC
Indirect Effects and Critical Habitat Effects	
2. Survival, growth, and reproduction of CRLF individuals via indirect effects on aquatic prey food supply (*i.e.*, fish, freshwater invertebrates, non-vascular plants)	2a. Most sensitive freshwater fish, *i.e*, channel catfish, freshwater invertebrate, *i.e*, waterflea (*Daphnia magna*), and aquatic plant $EC_{50,}$ *i.e.*, diatom (*Skeletonema costatum*) 2b. Most sensitive freshwater invertebrate (*D. magna*) and fish (*P. promelas*) chronic NOAEC
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, food supply, and/or primary productivity (*i.e.*, aquatic plant community)	3a. Vascular plant (duckweed; *Lemna gibba*) acute EC_{50} 3b. Non-vascular plant acute EC_{50} (diatom; *S. costatum*)
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation	No terrestrial plant toxicity data are available for iprodione.
Terrestrial-Phase CRLF (Juveniles and adults)	
Direct Effects	
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Most sensitive bird[b] (Northern bobwhite quail; *Colinus virginianus*) acute oral LD_{50} and subacute dietary LC_{50} 5b. Most sensitive bird[b] (*C. virginianus*) chronic NOAEC
Indirect Effects and Critical Habitat Effects	
6. Survival, growth, and reproduction of CRLF individuals via effects on terrestrial prey (*i.e.*,terrestrial invertebrates, small mammals , and frogs)	6a. Most sensitive terrestrial invertebrate (honeybee; *Apis mellifera*) acute contact LD_{50} and vertebrate (laboratory rat; *Ratus norvegicus*) acute oral LC_{50} (guideline) 6b. Most sensitive terrestrial invertebrate and vertebrate (*R. norvegicus*) chronic NOAEC
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian and upland vegetation)	No terrestrial plant toxicity data are available for iprodione.

[a] Adult frogs are no longer in the "aquatic phase" of the amphibian life cycle; however, submerged adult frogs are considered "aquatic" for the purposes of this assessment because exposure pathways in the water are considerably different that exposure pathways on land.
[b] Birds are used as surrogates for terrestrial phase amphibians.

[8] All registrant-submitted and open literature toxicity data reviewed for this assessment are included in Appendix A.

2.8.2 Assessment Endpoints for Designated Critical Habitat

As previously discussed, designated critical habitat is assessed to evaluate actions related to the use of iprodione that may alter the PCEs of the CRLF's critical habitat. PCEs for the CRLF were previously described in Section 2.6. Actions that may modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the CRLF. Therefore, these actions are identified as assessment endpoints. It should be noted that evaluation of PCEs as assessment endpoints is limited to those of a biological nature (*i.e.*, the biological resource requirements for the listed species associated with the critical habitat) and those for which iprodione effects data are available. Adverse modification to the critical habitat of the CRLF includes, but is not limited to, those listed in Section 2.6.

Measures of such possible effects by labeled use of iprodione on critical habitat of the CRLF are described in **Table 17.** Some components of these PCEs are associated with physical abiotic features (e.g., presence and/or depth of a water body, or distance between two sites), which are not expected to be measurably altered by use of pesticides. Assessment endpoints used for the analysis of designated critical habitat are based on the adverse modification standard established by USFWS (2006).

Table 17. Summary of Assessment Endpoints and Measures of Ecological Effect for Primary Constituent Elements of Designated Critical Habitat [a].

Assessment Endpoint	Measures of Ecological Effect
Aquatic-Phase CRLF PCEs ***(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)***	
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	a. Most sensitive aquatic plant (nonvascular *S. costatum* and vascular *L. gibba*) EC_{50} No terrestrial plant toxicity data are available for iprodione.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	a. Most sensitive aquatic plant (nonvascular *S. costatum* and vascular *L. gibba*) EC_{50} b. No terrestrial plant toxicity data are available for iprodione
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	a. Most sensitive acute LC_{50} values for fish (*I. punctatus*) and freshwater invertebrate (*D. magna*) b. Most sensitive NOAEC values for fish (*P. promelas*) and freshwater invertebrates (*D. magna*)
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae)	a. Most sensitive aquatic plant (nonvascular *S. costatum* and vascular *L. gibba*) EC_{50}
Terrestrial-Phase CRLF PCEs ***(Upland Habitat and Dispersal Habitat)***	
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	a. No terrestrial plant toxicity data are available for iprodione Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX) b. Most sensitive food source acute EC_{50}/LC_{50} and NOAEC values for terrestrial vertebrates (*R. norvegicus*) and invertebrates (*A. mellifera*), birds (*C. virginianus*), and freshwater fish (*I. punctatus*).
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	

[a] Physico-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

2.9 Conceptual Model

2.9.1 Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (*i.e.*, changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (U.S. EPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of iprodione to the environment. The following risk hypotheses are presumed for this endangered species assessment:

The labeled use of iprodione within the action area may:

- directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- indirectly affect the CRLF by reducing or changing the composition of food supply;
- indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the aquatic plant community in the ponds and streams comprising the species' current range and designated critical habitat, thus affecting primary productivity and/or cover;
- indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the terrestrial plant community (i.e., riparian habitat) required to maintain acceptable water quality and habitat in the ponds and streams comprising the species' current range and designated critical habitat;
- modify the designated critical habitat of the CRLF by reducing or changing breeding and non-breeding aquatic habitat (via modification of water quality parameters, habitat morphology, and/or sedimentation);
- modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- modify the designated critical habitat of the CRLF by reducing or changing upland habitat within 200 ft of the edge of the riparian vegetation necessary for shelter, foraging, and predator avoidance.
- modify the designated critical habitat of the CRLF by reducing or changing dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.
- modify the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

2.9.2 Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the iprodione release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual models for terrestrial and aquatic exposures are shown in **Figure 7** and **Figure 8**, respectively, which include the conceptual models for the aquatic and terrestrial PCE components of critical habitat.

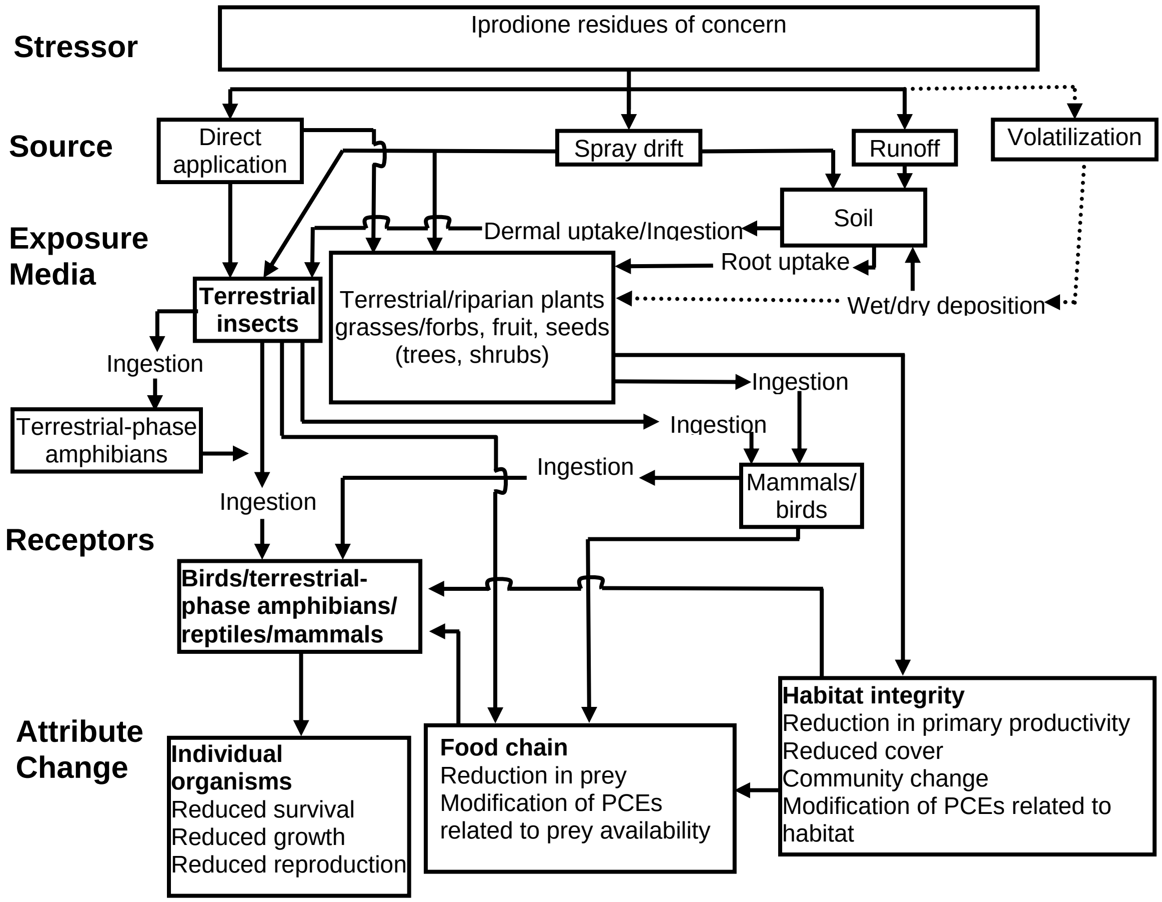


Figure 7. Conceptual Model for Iprodione Effects on Terrestrial Phase of the CRLF.

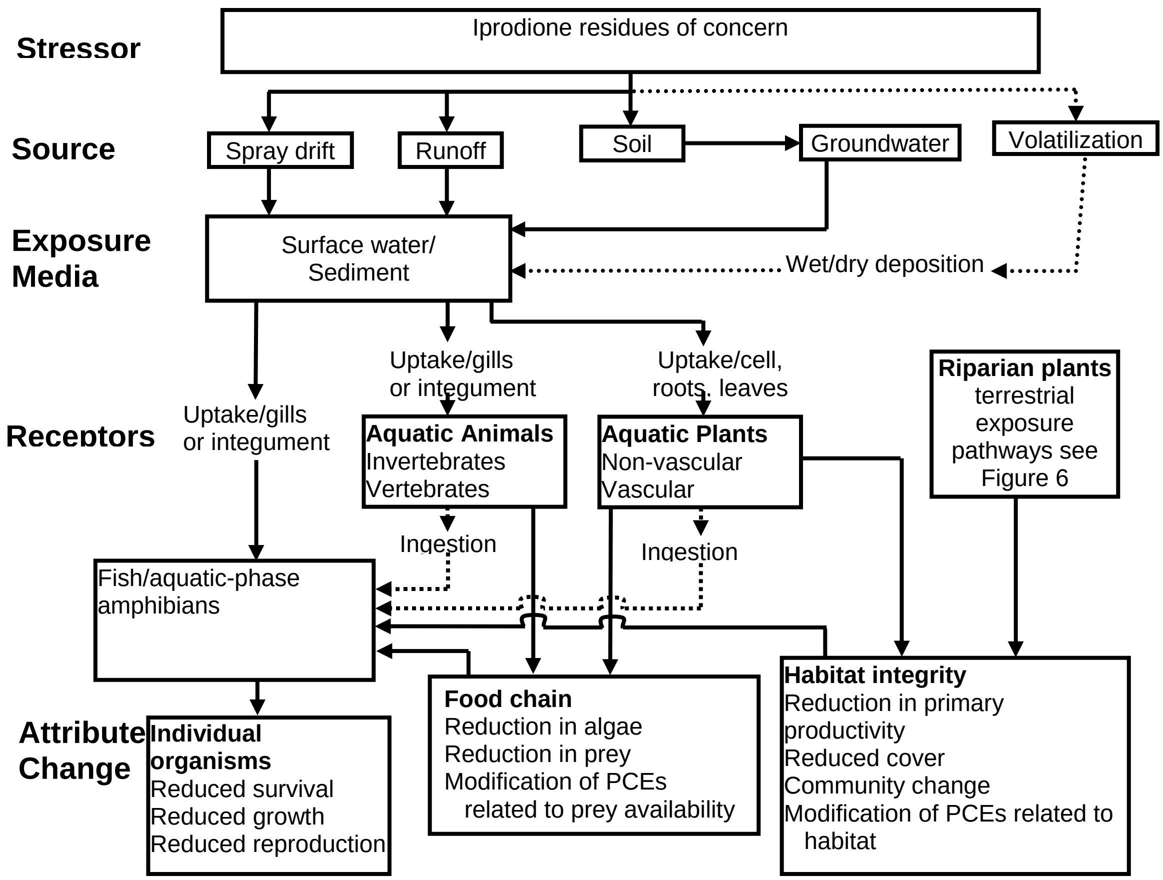


Figure 8. Conceptual Model for Iprodione Effects on Aquatic Phase of the CRLF.

2.10 Analysis Plan

In order to address the risk hypothesis, the potential for direct and indirect effects to the CRLF, its prey, and its habitat is estimated. In the following sections, the use, environmental fate, and ecological effects of iprodione are characterized and integrated to assess the risks. This is accomplished using a risk quotient (ratio of exposure concentration to effects concentration) approach. Although risk is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. However, as outlined in the Overview Document (U.S. EPA, 2004), the likelihood of effects to individual organisms from particular uses of iprodione is estimated using the probit dose-response slope and either the level of concern (discussed below) or actual calculated risk quotient value.

2.10.1 Measures to Evaluate the Risk Hypothesis and Conceptual Model

2.10.1.1 Measures of Exposure

The environmental fate properties of iprodione along with available monitoring data indicate that runoff and spray drift are the principle potential transport mechanisms of iprodione to the aquatic and terrestrial habitats of the CRLF. In addition, iprodione and 3,5-DCA may have the potential to reach ground water. Iprodione is not expected to volatilize. In this assessment, transport of iprodione through runoff and spray drift is considered in deriving quantitative estimates of iprodione exposure to CRLF, its prey and its habitats.

Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of iprodione using maximum labeled application rates and methods of application. The models used to predict aquatic EECs are the Pesticide Root Zone Model coupled with the Exposure Analysis Model System (PRZM/EXAMS). The model used to predict terrestrial EECs on food items is T-REX. These models are parameterized using relevant reviewed registrant-submitted environmental fate data.

PRZM (v3.12.2, May 2005) and EXAMS (v2.98.4.6, April 2005) are screening simulation models coupled with the input shell pe5.pl (Aug 2007) to generate daily exposures and 1-in-10 year EECs of iprodione that may occur in surface water bodies adjacent to application sites receiving iprodione through runoff and spray drift. PRZM simulates pesticide application, movement and transformation on an agricultural field and the resultant pesticide loadings to a receiving water body via runoff, erosion and spray drift. EXAMS simulates the fate of the pesticide and resulting concentrations in the water body. The standard scenario used for ecological pesticide assessments assumes application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body, 2-meters deep (20,000 m^3 volume) with no outlet. PRZM/EXAMS was used to estimate screening-level exposure of aquatic organisms to iprodione. The measure of exposure for aquatic species is the 1-in-10 year return peak or rolling mean concentration. The 1-in-10 year peak is used for estimating acute exposures of direct effects to the CRLF, as well as indirect effects to the CRLF through effects to potential prey items, including: algae, aquatic invertebrates, fish and frogs. The 1-in-10-year 60-day mean is used for assessing chronic exposure to the CRLF and fish and frogs serving as prey items; the 1-in-10-year 21-day mean is used for assessing chronic exposure for aquatic invertebrates, which are also potential prey items.

Three sets of aquatic EECs were derived: 1) iprodione only; 2) iprodione + all major degradates; 3) 3,5-DCA only. Iprodione only EECs were derived by modeling iprodione's chemical properties (e.g., molecular weight, vapor pressure) and half-lives as well as iprodione application rates. EECs for iprodione + all major degradates were derived using application rates and chemical properties of iprodione and half-lives that were representative of the total residues of concern (i.e., iprodione and its major degradates). EECs for 3,5-DCA were determined using chemical properties of 3,5-DCA and by assuming that 100% of iprodione applied to a use site is transformed to 3,5-DCA (i.e., by converting the application rates of iprodione to be specific to 3,5-DCA using the molecular weight of 3,5-DCA).

Exposure estimates for the terrestrial-phase CRLF and terrestrial invertebrates and mammals (serving as potential prey) assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.4.1, 10/09/2008). This model incorporates the Kenega nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper limit values from the nomograph represented high end residue values from actual field measurements (Hoerger and Kenega, 1972). For modeling purposes, direct exposures of the CRLF to iprodione through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey (small mammals) are assessed using the small mammal (15 g) which consumes short grass. The small bird (20g) consuming small insects and the small mammal (15g) consuming short grass are used because these categories represent the largest RQs of the size and dietary categories in T-REX that are appropriate surrogates for the CRLF and one of its prey items. Estimated exposures of terrestrial insects to iprodione are bound by using the dietary based EECs for small insects and large insects.

Birds are currently used as surrogates for terrestrial-phase CRLF. However, amphibians are poikilotherms (body temperature varies with environmental temperature) while birds are homeotherms (temperature is regulated, constant, and largely independent of environmental temperatures). Therefore, amphibians tend to have much lower metabolic rates and lower caloric intake requirements than birds or mammals. As a consequence, birds are likely to consume more food than amphibians on a daily dietary intake basis, assuming similar caloric content of the food items. Therefore, the use of avian food intake allometric equation as a surrogate to amphibians is likely to result in an over-estimation of exposure and risk for reptiles and terrestrial-phase amphibians. Therefore, T-REX (version 1.4.1) has been refined to the T-HERPS model (v. 1.0), which allows for an estimation of food intake for poikilotherms using the same basic procedure as T-REX to estimate avian food intake.

The spray drift model, AgDRIFT is used to assess exposures of terrestrial phase CRLF and its prey to iprodione residues of concern deposited on terrestrial habitats by spray drift. In addition to the buffered area from the spray drift analysis, the downstream extent of iprodione that exceeds the LOC for the effects determination is also considered.

2.10.1.2 Measures of Effect

Data identified in Section 2.8 are used as measures of effect for direct and indirect effects to the CRLF. Data were obtained from registrant submitted studies or from literature studies identified by ECOTOX. The ECOTOXicology database (ECOTOX) was searched in order to provide more ecological effects data and in an attempt to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by the USEPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division.

The assessment of risk for direct effects to the terrestrial-phase CRLF makes the assumption that toxicity of iprodione to birds is similar to or less than the toxicity to the terrestrial-phase CRLF. The same assumption is made for fish and aquatic-phase CRLF. Algae, aquatic invertebrates, fish, and amphibians represent potential prey of the CRLF in the aquatic habitat. Terrestrial invertebrates, small mammals, and terrestrial-phase amphibians represent potential prey of the CRLF in the terrestrial habitat. Aquatic, semi-aquatic, and terrestrial plants represent habitat of CRLF.

The acute measures of effect used for animals in this screening level assessment are the LD_{50}, LC_{50} and EC_{50}. LD stands for "Lethal Dose", and LD_{50} is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for “Lethal Concentration” and LC_{50} is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for “Effective Concentration” and the EC_{50} is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for “No Observed-Adverse-Effect-Level” and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (*i.e.*, “No-Observed-Adverse-Effect-Concentration”) is the highest test concentration at which none of the observed effects were statistically different from the control. The NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (*i.e.*, EC_{25} for terrestrial plants and EC_{50} for aquatic plants).

It is important to note that the measures of effect for direct and indirect effects to the CRLF and its designated critical habitat are associated with impacts to survival, growth, and fecundity, and do not include the full suite of sublethal effects used to define the action area. According the Overview Document (USEPA 2004), the Agency relies on effects endpoints that are either direct measures of impairment of survival, growth, or fecundity or endpoints for which there is a scientifically robust, peer reviewed relationship that can quantify the impact of the measured effect endpoint on the assessment endpoints of survival, growth, and fecundity.

2.10.1.3 Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from agricultural and non-agricultural uses of iprodione, and the likelihood of direct and indirect effects to CRLF in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. For the assessment of iprodione risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency’s levels of concern (LOCs) (USEPA, 2004) (see Appendix D).

For this endangered species assessment, listed species LOCs are used for comparing RQ values for acute and chronic exposures of iprodione directly to the CRLF. If estimated exposures directly to the CRLF of iprodione resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is "may affect". When considering indirect effects to the CRLF due to effects to animal prey (aquatic and terrestrial invertebrates, fish, frogs, and mice), the listed species LOCs are also used. If estimated exposures to CRLF prey of iprodione resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is a "may affect." If the RQ being considered also exceeds the non-listed species acute risk LOC, then the effects determination is a LAA. If the acute RQ is between the listed species LOC and the non-listed acute risk species LOC, then further lines of evidence (*i.e*. probability of individual effects, species sensitivity distributions) are considered in distinguishing between a determination of NLAA and a LAA. When considering indirect effects to the CRLF due to effects to algae as dietary items or plants as habitat, the non-listed species LOC for plants is used because the CRLF does not have an obligate relationship with any particular aquatic and/or terrestrial plant. If the RQ being considered for a particular use exceeds the non-listed species LOC for plants, the effects determination is "may affect". Further information on LOCs is provided in **Appendix D**.

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (U.S. EPA, 2004). As part of the risk characterization, an interpretation of acute RQ for listed species is discussed. This interpretation is presented in terms of the chance of an individual event (*i.e*., mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to iprodione on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. In addition, the acute RQ is entered as the desired threshold.

2.10.1.4 Data Gaps

There are no acceptable terrestrial plant toxicity data involving exposures to iprodione in either registrant-submitted or open literature studies.

Little data are available to characterize the fate and effects of 3,5-DCA in the environment. No data are available to characterize the fate and effects of iprodione's other major environmental fate degradates.

3.0 Exposure Assessment

3.1 Surface Water Exposure Assessment

3.1.1 Modeling Approach

Aquatic exposures are quantitatively estimated using PRZM/EXAMS for all of assessed uses using scenarios that represent high exposure sites for iprodione use. Each of these sites represents a 10 hectare field that drains into a 1-hectare pond that is 2 meters deep and has no outlet. Exposure estimates generated using the standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either shallower or have large drainage areas (or both). Shallow water bodies tend to have limited additional storage capacity, and thus, tend to overflow and carry pesticide in the discharge whereas the standard pond has no discharge. As watershed size increases beyond 10 hectares, at some point, it becomes unlikely that the entire watershed is planted to a single crop, which is all treated with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they tend to persist for only short periods of time and are then carried downstream.

In order to quantify exposures and effects of iprodione on non-target, aquatic organisms, EECs are derived for all uses of iprodione that are relevant to CA. These EECs are based on total residues of concern which include parent iprodione and all degradates that retain the 3,5-DCA moiety. These total residue EECs are used in combination with effects data to generate RQs for the CRLF, its prey and its habitat. In the Risk Description (Section 5.2.1.1), additional EECs are generated to characterize exposures to aquatic animals to iprodione alone and to 3,5-DCA alone. Although 3,5-DCA can also be present in the environment as a result of degradation of vinclozolin (another fungicide used on turf grass in CA), EECs for 3,5-DCA presented in this assessment are only relevant to uses of iprodione. Example input/output files for PRZM/EXAMS are provided in **Appendix E**.

3.1.2 PRZM scenarios

PRZM scenarios intended to represent specific uses in CA were used to model those specific uses. In cases where no PRZM scenario was available for a particular use (i.e., for caneberries and bushberries, radish and rutabaga), surrogate scenarios were assigned (**Table 18**). Explanations of why surrogates were selected for specific uses are provided below.

Table 18. PRZM scenario assignments according to uses of iprodione.

Use	PRZM scenario
Almonds	CA Almond STD
Beans	CA Row Crop RLF
Berries[1]	CA Wine Grapes RLF
Canola	CA wheat RLF
Carrots	CA Row Crop RLF
Cole Crops [2]	CA Cole Crop RLF
Cotton	CA Cotton STD
Crucifer	CA Cole Crop RLF
Garlic	CA Garlic RLF
Grapes	CA Wine Grapes RLF
Lettuce	CA Lettuce STD
Onions	CA Onion STD
Ornamentals	CA Nursery
Peanuts	CA Row Crop RLF
Potatoes	CA Potato RLF
Radishes	CA Onion STD
Rutabagas	CA Potato RLF
Strawberries	CA Strawberry (non plastic) RLF
Stone Fruit [3]	CA Fruit STD
Turf	CA Turf RLF
Turnip greens	CA lettuce STD

[1]specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[2] specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3]apricots, cherries, nectarines, peaches, plums, prunes

For caneberries and bushberries, the CA winegrape scenario was used as a surrogate. This scenario is intended to represent a field in Northern Costal CA (Sonoma, Napa, Lake and Mendocino Counties). The meteorological station for this scenario is located in San Francisco. According to NASS, caneberries are mostly grown in Santa Cruz County and blueberries are grown in the coastal valley. The meteorological station and the soil of the CA winegrape scenario are in close proximity to Santa Cruz County (which is to the south) and overlap in range with the region of blueberry cultivation. Therefore, this scenario was considered to be a suitable surrogate, since it is expected to have similar meteorological and soil conditions to fields where caneberries and blueberries are grown in CA.

According to USDA, crucifer crops include vegetables in the Brassiceae family (http://www.ars-grin.gov/npgs/cgc_reports/crucifer1201.htm). These include cole crops, radiccio, arrugala, radish and others. Since crucifer overlaps with cole crops, the CA cole crop scenario is used to model this use of iprodione.

The CA lettuce scenario was selected to represent production of turnip greens. It is expected that lettuce and turnip greens have similar cultivation requirements.

The CA onion scenario is intended to represent an onion field in Kern County. This scenario is used to represent radishes since it represents a root crop similar to onion. The two crops are potentially grown in similar areas.

The CA potato scenario is used to represent cultivation of potatoes and rutabagas. This scenario is representative of a field in Kern County, which is to the south of Merced Co. No NASS data have been located to clarify which counties in CA grow rutabagas. Therefore, it is assumed that this crop would grow under similar conditions as the potato.

It should be noted that the CA Row Crop scenario is intended to represent production of carrots, beans and other crops in CA, and is therefore, directly relevant to these uses. Peanuts are considered row crops and are classified in this category.

The CA wheat scenario was selected to represent production of canola, which is also a grain crop like wheat. It is expected that wheat and canola have similar cultivation requirements.

3.1.3 Chemical Specific Model Inputs for Iprodione Residues of Concern

The appropriate chemical-specific PRZM input parameters are selected from reviewed physical, chemical and environmental fate data submitted by the registrant (**Table 5** and in **Table 6**) and in accordance with EFED water model input parameter selection guidance (U.S. EPA 2002). The input parameters for relevant to the fate of iprodione residues used in PRZM and EXAMS are in **Table 19**.

Table 19. PRZM/EXAMS input parameters relevant to the fate of iprodione residues of concern.

Input Parameter	Value	Comments
Molecular Wt. (g/mol)	330.2	Value for iprodione; See **Table 5**.
Henry's Law Constant (atm-m^3/mol)	9.0×10^{-9}	Value for iprodione; See **Table 5**.
Vapor pressure (torr)	2.7×10^{-7}	Value for iprodione; See **Table 5**.
Solubility in water (mg/L @ pH 7, 20^{o}C)	13	Value for iprodione; See **Table 5**.
Hydrolysis half-life (days)	0*	Iprodione residues of concern are stable to hydrolysis at pH 7 (MRID 41885401)
Aqueous photolysis half-life (days)	67	Value is representative of iprodione half-life. No major degradates were observed in available aqueous photolysis study (MRID 41861901).
Aerobic Soil Metabolism Half-life (days)	0*	It is assumed that iprodione residues of concern are stable, based on an aerobic soil metabolism study indicating that 3,5-DCA (iprodione's terminal degradate) is stable (MRID 45239201).
Aerobic Aquatic Metabolism Half-life (days)	0*	Input parameter guidance indicates that in the case that a chemical is stable to hydrolysis, this parameter should be defined as 2x the aerobic soil metabolism half-life used in PRZM (which is 0). In an aerobic aquatic metabolism study (MRIDs 41927601 and 42503801), iprodione degraded with an observed DT_{50} of 3-7 days. However, the pH of the system was 8.5, which is a level at which hydrolysis of iprodione is a major mechanism of degradation. RP 30228 and RP32490 were observed as major degradates. Given that concentrations of 3,5-DCA increased throughout the study, the 30 d study was not necessarily of sufficient duration to capture the full formation and decline of 3,5-DCA
Anaerobic Aquatic Metabolism Half-life (days)	0*	In an anaerobic aquatic metabolism study, iprodione degraded with an observed DT_{50} of 7-14 days in anaerobic silt loam sediment (MRID 41755801); however, it appeared that this was attributed to hydrolysis. A sterile control showed that iprodione degraded at about the same rate. Thus degradation of the parent does not appear to be microbially mediated. Several other degradates of concern were observed in this study.
K_{oc} (L/kg_{OC})	553	Mean of K_{oc} values for iprodione and 3,5-DCA (**Table 8 and 9**).

*A value of 0 indicates that iprodione total residues of concern are stable to degradation.

3.1.4 Use-Specific Model Inputs for Iprodione Residues of Concern

Use specific parameters include application methods and rates, that are based on current labels (**Table 20**). For use patterns where both ground and aerial spray applications are permitted, aerial applications were modeled since aerial applications have higher spray drift fractions, and thus, higher aquatic EECs. The impact of assuming the higher spray drift values corresponding to aerial applications on EECs is discuss further in the Risk Description (Section 5.2.1.1).

As noted in the use characterization, iprodione labels indicate that applications to areas adjacent to water bodies (including lakes, reservoirs, rivers, streams, marshes, natural ponds, commercial fish ponds and estuaries) should only be made where a 25 foot vegetated buffer strip exists. In order to account for this label language, AgDRIFT was used to determine the % deposition in the EFED standard pond (used with EXAMS) that can be attributed to spray drift. For aerial applications, the spray drift fraction is 0.093. For ground applications, the spray drift fraction is 0.027. For seed treatments, it was assumed that the drift fraction is 0.

Table 20. PRZM/EXAMS input parameters relevant to the use of iprodione.

Use(s)	Max ap rate (kg a.i./ha)	# aps / season	Minimum application interval (days)[1]	Initial application timing[1]	Initial application date[2] (brief explanation)	Application method(s)[1]	Spray drift fraction[3]	CAM[4]	IPSCND
Almonds	0.56	4	7[5]	pink bud	Feb 15 (USDA profile for CA almonds)	ground spray, chemigation, air spray	0.093	2	1
Beans	1.12	2	5	bloom	Feb 1 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	0.14	1	not applicable	at planting	Dec 15 (2 weeks before emergence)	seed treatment	0	4	NA
Berries[6]	1.12	4	14	bloom	April 1 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Canola (foliar)	1.12	5	7[5]	2-4 leaf stage	Jan 1 (emergence date)	ground spray, chemigation, air spray	0.093	2	1
Canola (seed treatment)	0.75	1	not applicable	at planting	Dec 15 (2 weeks before emergence)	seed treatment	0	4	NA
Carrot (foliar)	1.12	4	7	foliar	Feb 1 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Carrot (seed treatment)	0.37	1	not applicable	at planting	Dec 15 (2 weeks before emergence)	seed treatment	0	4	NA
Cole crops[7] and Crucifer (foliar)	1.12	5	7[5]	2-4 leaf stage	Jan 1 (emergence date)	ground spray, chemigation, air spray	0.093	2	1
conifers	1.40	4	7	foliar	March 15 (arbitrary date to represent spring)	sprayer, chemigation, drip	0.027	2	1
Cotton	0.30	1[8]	not applicable	at planting	April 15 (2 weeks before emergence)	soil in-furrow treatment	0.027	4	NA
Garlic	2.24	1	not applicable	at planting	Sept 15 (2 weeks before emergence)	soil in-furrow treatment	0.027	4	NA
Grapes	1.12	4	7[5]	bloom	March 1 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Grapes	1.12	4	7[5]	bloom	March 1 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
kohlrabi (seed treatment)	0.47	1	not applicable	at planting	Dec 15 (2 weeks before emergence)	seed treatment	0	4	NA

Use(s)	Max ap rate (kg a.i./ha)	# aps / season	Minimum application interval (days)[1]	Initial application timing[1]	Initial application date[2] (brief explanation)	Application method(s) [1]	Spray drift fraction[3]	CAM[4]	IPSCND
Lettuce (air ap)	1.12	3	10	3 leaf stage	Feb 16 (crop emergence)	air spray	0.093	2	1
Lettuce (ground ap)	1.12	4	10	3 leaf stage	Feb 16 (crop emergence)	ground spray, chemigation	0.027	2	1
Onion	0.84	5	14	foliar	Feb 16 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Ornamentals (drench - 1 application)	25.15	1[10]	14	after transplant	March 15 (arbitrary date to represent spring)	drench	0	2	1
Ornamentals (drench - 26 applications)	25.15	26 [10]	14	after transplant	Jan 1	drench	0	2	1
Ornamentals (foliar-1 application)	3.14	1[11]	10	foliar	March 15 (arbitrary date to represent spring)	ground spray, chemigation	0.027	2	1
Ornamentals (foliar-26 applications)	3.14	26 [11]	10	foliar	Jan 1	ground spray, chemigation	0.027	2	1
Peanut	1.12	3	14	foliar	Feb 1 (1 month after crop emergence)	ground spray, chemigation	0.027	2	1
Potato	1.12	4	10	foliar	March 16 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Radish (foliar)	1.12	5	7[5]	bloom	Feb 16 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Radish (seed treatment)	1.68	1	not applicable	at planting	Jan 1 (emergence date)	seed treatment	0	4	NA
Rutabaga (foliar)	1.12	5	7[5]	bloom	March 16 (1 month after crop emergence)	ground spray, chemigation, air spray	0.093	2	1
Rutabaga (seed treatment)	0.19	1	not applicable	at planting	Feb 1 (2 weeks before crop emergence)	seed treatment	0	4	NA
Stone fruit[9]	1.54	2	7[5]	bud	Feb 15 (1 month after crop emergence)	air and ground spray	0.093	2	1
Strawberry	1.12	1	not applicable	bloom	Feb 1 (1 month after crop emergence)	ground spray, air spray, dip treatment	0.093	2	1
turf [12] (spring)	9.15	2[14]	14	foliar	September 15 (arbitrary date to represent fall)	ground spray	0.027	2	1
turf [12] (fall)	9.15	2[14]	14	foliar	March 15 (arbitrary date to represent spring)	ground spray	0.027	2	1

Use(s)	Max ap rate (kg a.i./ha)	# aps / season	Minimum application interval (days)[1]	Initial application timing[1]	Initial application date[2] (brief explanation)	Application method(s) [1]	Spray drift fraction[3]	CAM[4]	IPSCND
turf [13] (spring)	6.10	4[15]	14	foliar	September 15 (arbitrary date to represent fall)	ground spray	0.027	2	1
turf[13] (fall)	6.10	4[15]	14	foliar	March 15 (arbitrary date to represent spring)	ground spray	0.027	2	1
turnip greens (foliar)	1.12	5	7[5]	2-4 leaf stage	Feb 16 (crop emergence)	ground spray, chemigation, air spray	0.093	2	1
turnip greens (seed treatment)	0.19	1	not applicable	at planting	Jan 1 (2 weeks before emergence)	seed treatment	0	4	NA

NA = not applicable
[1] according to label
[2] based on label description of timing and PRZM scenario
[3] Calculated using AgDRIFT with assumption of 25 foot vegetative buffer
[4] CAM = 2 is a foliar application, CAM = 4 is a soil (in-furrow) application. For CAM = 4, assume a 4 cm incorporation depth based on default assumption for PRZM.
[5]When minimum application interval is not defined on product labels, it was assumed that a 7-d interval is a reasonable application interval.
[6] specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[7] specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[8]assumed based on application method (not stated on the labels)
[9] specifically: apricots, cherries, nectarines, peaches, plums, prunes
[10]No limit defined on labels. To bound EECs for the drench application, it was assumed that 1 application represented the minimum number of applications per year and that 26 represented the maximum number of applications per year (limit of PRZM/EXAMS pe5 shell).
[11]No limit defined on labels. To bound EECs for the foliar application, it was assumed that 1 application represented the minimum number of applications per year and that 26 represented the maximum number of applications per year.
[12]golf course - greens, tees and aprons
[13] golf course, sod farm, commercial industrial lawns
[14]Plus a 3rd application of 5.48 lbs a.i./A (6.14 kg a.i./ha)
[15]Plus a 5th application of 2.04 lbs a.i./A (2.29 kg a.i./ha)

3.1.5 Modeling Results

The aquatic EECs for the various scenarios and application practices are listed in **Table 21.** The highest EECs were associated with the use of iprodione on ornamental plants using drench application and where labels did not specify the maximum number of applications per year.

Table 21. Aquatic EECs (µg/L) for Iprodione Uses in California.

Crops Represented	Peak EECs	21-day average EECs	60-day average EECs
Almonds	171	171	170
Beans	224	223	222
Broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	14.6	14.4	14.4
Berries[1]	321	319	317
Canola (foliar)	812	811	809
canola (seed treatment)	43.0	41.9	40.7
Carrot (foliar)	450	448	446
Carrot (seed treatment)	16.5	16.2	16.2
Cole Crops [2] and Crucifer (foliar)	1179	1179	1179
Conifers	324	324	322
Cotton	8.65	8.62	8.59
Garlic	59.8	59.4	59.0
Grapes	318	316	315
Kohlrabi (seed treatment)	49.1	48.4	48.2
Lettuce (air application)	660	658	655
Lettuce (ground application)	728	728	727
Onions	269	269	267
Ornamentals (drench - 1 application)	1575	1538	1538
Ornamentals (drench - 26 applications)	52050	51760	51270
Ornamentals (foliar-1 application)	249	246	246
Ornamentals (foliar-26 applications)	7683	7654	7609
Peanuts	211	210	209
Potatoes	281	279.1	277.1
Radishes (foliar)	358	357	355
Radishes (seed treatment)	16.0	16.0	16.0
Rutabagas (foliar)	348	346	344
Rutabagas (seed treatment)	2.17	2.17	2.17
Stone Fruit [3]	220	219	218
Strawberries	184	183	183
Turf (golf course - greens, tees and aprons) (fall)	1379	1370	1369
Turf (golf course - greens, tees and aprons) (spring)	829	826	821
Turf (golf course, sod farm, commercial industrial lawns) (fall)	1529	1520	1519
Turf (golf course, sod farm, commercial industrial lawns) (spring)	903	901	898
Turnip greens (foliar)	1118	1108	1108

Turnip greens (seed treatment)	23.3	23.2	23.1

[1] specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[2] specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3] specifically: apricots, cherries, nectarines, peaches, plums, prunes

3.1.6 Surface Water Monitoring Data

California-specific monitoring data for iprodione and its degradate of concern, 3,5-DCA, are available from the United States Geological Survey's (USGS) National Water Quality Assessment (NAWQA; USGS 2009). These data are summarized below. No data are available in the CDPR Surface Water Database for iprodione or 3,5-DCA.

Iprodione was detected in 27% of 434 surface water samples taken by USGS in CA from 2001-2009. Of the 434 samples, 9% had an estimated value above 1.42 µg/L. The maximum reported concentration was estimated at 141µg/L. The level of quantification of iprodione ranged 0.01-1.42 µg/L. 3,5-DCA was detected in 1.3% of 308 surface water samples collected from 2001-2009 in CA. The maximum reported concentration of 3,5-DCA was 0.0268 µg/L. The level of quantification of 3,5-DCA ranged 0.004-0.012 µg/L (USGS 2009).

It should be noted that available monitoring data are not necessarily targeted to detect maximum environmental concentrations of iprodione or 3,5-DCA, and therefore may not be representative of peak concentrations of these chemicals present in the field.

Following the 1998 iprodione RED, surface water monitoring was required for iprodione and the degradate 3,5-DCA. The surface water monitoring program started in 2006 in watersheds that contained high numbers of golf courses. This program is ongoing and only preliminary results have been received. The preliminary report did not provide adequate ancillary information to enable thorough evaluation of the data. Surface water detections of iprodione were higher with 3 detections greater than 1 µg/L including 8.8 µg/L at a golf course pond, 1.1 µg/L at a golf course pond, and 2.6 µg/L at unknown type of surface water (identified as a greenhouse). Surface water detections of 3,5-DCA include 4 µg/L and 1.5 µg/L in golf course ponds, along with three other golf course pond samples less than 1 µg/L. The iprodione/3,5-DCA assessment may need to be reevaluated upon receipt of the final monitoring reports.

3.2 Ground Water Exposure Assessment

3.2.1 Modeling Approach

In order to estimate ground water EECs for iprodione residues of concern, Scigrow v2.3 was run with the input parameters provided in **Table 22**.

Table 22. Input parameters for Scigrow v.2.3 used to represent iprodione residues of concern.

Input Parameter	Value	Comments
Maximum rate/application (lbs a.i./A)	22.44	Based on highest single application rate for iprodione (drench application to ornamentals)
# applications/year	26	The label does not specify a maximum number of applications per year for this use. Based on a minimum application interval of 14 d, a maximum of 26 applications may be made per year.
Koc (mL/g OC)	553	Mean of K_{oc} values for iprodione and 3,5-DCA (**tables 8 and 9**)
Soil metabolism half-life (days)	10,000	Selected large value to represent stable.

3.2.2 Modeling Results

The resulting ground water EEC was 898 µg/L. This value is 2 orders of magnitude lower than the surface water EECs generated for this use (approximately 50,000 µg/L) using PRZM/EXAMS, indicating that the surface water EECs represent more conservative values.

3.2.3 Ground Water Monitoring Data

During 2001-2008, 327 ground water samples contained no detectable levels of iprodione. 3,5-DCA was detected in 5.7% of 229 ground water samples collected in CA. The maximum detected concentration of 3,5-DCA was 0.0983 µg/L (USGS 2009).

In the 2000 vinclozolin RED (vinclozolin has the same 3,5-DCA degradate) the document identified additional generic data requirements. Under the heading "Surface/Groundwater Monitoring" the document stated that "*registrants for vinclozolin and iprodione will be issued a Data Call-in* [DCI]", *separate from the generic Data Call-in . . . requiring surface water and ground water monitoring studies.*" In turn, ground water monitoring of iprodione and the degradate 3,5-DCA was added to the registrant's monitoring requirements. A DCI was issued for a prospective ground water monitoring study in February 2001. A ground water monitoring program was initiated by the registrant in conjunction with Suffolk County New York after iprodione was reported in Suffolk County ground water. This program is ongoing and only preliminary results have been received. The preliminary report did not provide adequate ancillary information to enable thorough evaluation of the data. For example, although the report indicates that samples were taken from private drinking water wells, irrigation wells, vineyard wells, and golf course wells, the spatial context of the sampling locations were not given; therefore, it is unknown whether the sampling locations are representative of iprodione use areas. Additionally, well depths were not given for most of the samples which would be required in order to evaluate whether these are reasonable sampling wells. For some of the samples it was not apparent whether the samples were taken from ground water or from surface water.The intent of the report was to show that work had begun on the monitoring program rather than to provide conclusions regarding iprodione ground water issues. However, a cursory review of the reported results indicates that there were detections of iprodione and 3,5-DCA. All of the reported iprodione ground water detections were at concentrations less than 1 µg/L, except for one detection in an irrigation well that was 5.75 µg/L (well depth not given but water table depth was stated to be 80 ft). Lower and less frequent concentrations were reported for 3,5-DCA in ground water, with the maximum concentration of 0.44 µg/L in a golf course well.

3.3 Terrestrial Animal Exposure Assessment

T-REX (Version 1.4.1) is used to calculate dietary and dose-based EECs of iprodione for the CRLF and its potential prey (*e.g.* small mammals and terrestrial insects) inhabiting terrestrial areas. EECs used to represent the CRLF are also used to represent exposure values for frogs serving as potential prey of CRLF adults. T-REX simulates a 1-year time period. For this assessment, spray applications of iprodione are considered, as discussed in below.

Terrestrial EECs for foliar formulations of iprodione were derived for the uses summarized in **Table 23.** Given that no data on interception and subsequent dissipation from foliar surfaces is available for iprodione, a default foliar dissipation half-life of 35 days is used based on the work of Willis and McDowell (1987). Use specific input values, including number of applications, application rate and application interval are provided in **Table 23**. An example output from T-REX is available in **Appendix F**.

Table 23. Input Parameters for Foliar Applications Used to Derive Terrestrial EECs for Iprodione with T-REX.

Use (Application method)	Application rate (lbs a.i./A)	Number of Applications	Reapplication Interval (Days)
Almonds	0.5	4	7
Beans	1	2	5
Berries [1]	1	4	14
Canola	1	5	7
Carrots	1	4	7
Cole crops[2]	1	5	7
Conifers	1.25	4	7
Cotton	0.2719	1	NA
Crucifer	1	5	7
Garlic	2	1	NA
Grapes	1	4	7
Lettuce (aerial)	1	3	10
Lettuce (ground application)	1	4	10
Onions	0.75	5	14
Ornamentals (drench high)	22.44	26	14
Ornamentals (drench low)	22.44	1	NA
Ornamentals (foliar high)	2.805	26	10
Ornamentals (foliar low)	2.805	1	NA
Peanuts	1	3	14
Potatoes	1	4	10
Radishes	1	5	10
Rutabagas	1	5	7
Stone fruit [3]	1.3725	2	7
Strawberries	1	1	NA
Turf[4]	5.44	4	14
Turf [5]	8.16	2	14
Turnip greens	1	5	7

NA = not applicable
[1] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, and raspberries
[2] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3] Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[4] golf course, sod farms, commercial industrial lawns
[5] golf course: greens, tees and aprons; applications

T-REX is also used to calculate EECs for terrestrial insects exposed to iprodione. Dietary-based EECs calculated by T-REX for small and large insects (units of a.i./g) are used to bound an estimate of exposure to bees. Available acute contact toxicity data for bees exposed to iprodione (in units of µg a.i./bee), are converted to µg a.i./g (of bee) by multiplying by 1 bee/0.128 g. The EECs are later compared to the adjusted acute contact toxicity data for bees in order to derive RQs.

For modeling purposes, exposures of the CRLF to iprodione through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey are assessed using the small mammal (15 g) which consumes short grass. Upper-bound Kenega nomogram values reported by T-REX for these two organism types are used for derivation of EECs for the CRLF and its potential prey (**Table 24**). Dietary-based EECs for small and large insects reported by T-REX as well as the resulting adjusted EECs are available in **Table 25**. An example output from T-REX v. 1.4.1 is available in **Appendix F**.

Table 24. Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the CRLF and its Prey to Iprodione.

Use (Application method)	EECs for CRLF		EECs for Prey (small mammals)	
	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)
Almonds	222	253	395	376
Beans	257	293	457	436
Berries[1]	374	426	664	633
Canola	521	594	927	884
Carrots	444	506	789	752
Cole crops[2]	521	594	927	884
Conifers	555	632	986	941
Cotton	37	42	65	62
Crucifer	521	594	927	884
Garlic	270	308	480	458
Grapes	444	506	789	752
Lettuce (aerial)	337	383	598	571
Lettuce (ground application)	411	468	731	697
Onions	314	357	558	532
Ornamentals (drench high)	12502	14238	22225	21190
Ornamentals (drench low)	3029	3450	5386	5135
Ornamentals (foliar high)	2095	2387	3725	3552
Ornamentals (foliar low)	379	431	673	642
Peanuts	315	359	560	534
Potatoes	411	468	731	697
Radishes	521	594	927	884
Rutabagas	521	594	927	884
Stone fruit [3]	347	395	616	587
Strawberries	135	154	240	229
Turf [4]	2032	2315	3613	3445
Turf [5]	1936	2205	3443	3282
Turnip greens	521	594	927	884

[1] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, and raspberries
[2] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3] Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[4] golf course, sod farms, commercial industrial lawns
[5] golf course: greens, tees and aprons

Table 25. EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items from Iprodione.

Use (Application method)	Small Insect	Large Insect
Almonds	222	25
Beans	257	29
Berries[1]	374	42
Canola	521	58
Carrots	444	49
Cole crops[2]	521	58
Conifers	555	62
Cotton	37	4.1
Crucifer	521	58
Garlic	270	30
Grapes	444	49
Lettuce (aerial)	337	37
Lettuce (ground application)	411	46
Onions	314	35
Ornamentals (drench high)	12502	1389
Ornamentals (drench low)	3029	337
Ornamentals (foliar high)	2095	233
Ornamentals (foliar low)	379	42
Peanuts	315	35
Potatoes	411	46
Radishes	521	58
Rutabagas	521	58
Stone fruit [3]	347	39
Strawberries	135	15
Turf [4]	2032	226
Turf [5]	1936	215
Turnip greens	521	58

[1] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, and raspberries
[2] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[3] Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[4]golf course, sod farms, commercial industrial lawns
[5]golf course: greens, tees and aprons

In addition, T-REX is used to calculate EECs for small mammals consuming seeds that have been treated with iprodione. At a rate of 8.333 lbs a.i./cwt, the mammalian dose is 17,655 mg a.i./kg-bw/day.

3.4 Spray Drift Modeling

In cases where RQs exceed the LOC for terrestrial animals, AgDRIFT was used to characterize the distance from the edge of the treated field where the risk extends. For ground applications, this was accomplished using the Tier 1 ground setting, assuming a high boom and ASAE very fine to fine droplet size distribution (90^{th} percentile of data).

For aerial applications, this was accomplished using the Tier 1 aerial setting, assuming a ASAE fine to medium droplet size distribution (default).For airblast applications, this was accomplished using the Tier 1 orchard/airblast setting.These parameter values were selected to represent the most conservative assumptions allowed by the Tier 1 settings of AgDRIFT. A terrestrial assessment was conducted to determine the distance from the edge of the field where the point deposition was below the lbs a.i./A rate that was required to result in no LOC exceedances for a taxa of concern (*i.e.*, terrestrial-phase CRLF and mammals). The results of this spray drift assessment are described in context of their relative RQ values in the risk description of this assessment.

4.0 Effects Assessment

This assessment evaluates the potential for iprodione to directly or indirectly affect the CRLF or modify its designated critical habitat. As previously discussed in Section 2.7, assessment endpoints for the CRLF effects determination include direct toxic effects on the survival, reproduction, and growth of CRLF, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating effects to the PCEs, which are components of the critical habitat areas that provide essential life cycle needs of the CRLF. Direct effects to the aquatic-phase of the CRLF are based on toxicity information for freshwater fish, while terrestrial-phase effects are based on avian toxicity data, given that birds are generally used as a surrogate for terrestrial-phase amphibians. Because the frog's prey items and habitat requirements are dependent on the availability of freshwater fish and invertebrates, small mammals, terrestrial invertebrates, and aquatic and terrestrial plants, toxicity information for these taxa are also discussed. Acute (short-term) and chronic (long-term) toxicity information is characterized based on registrant-submitted studies and a comprehensive review of the open literature on iprodione.

As described in the Agency's Overview Document (U.S. EPA, 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include aquatic-phase amphibians, freshwater fish, freshwater invertebrates, aquatic plants, birds (surrogate for terrestrial-phase amphibians), mammals, terrestrial invertebrates, and terrestrial plants.

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (U.S. EPA, 2004). Open literature data presented in this assessment were obtained from ECOTOX information obtained on February 28, 2009. In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

(1) the toxic effects are related to single chemical exposure;
(2) the toxic effects are on an aquatic or terrestrial plant or animal species;
(3) there is a biological effect on live, whole organisms;
(4) a concurrent environmental chemical concentration/dose or application rate is reported; and
(5) there is an explicit duration of exposure.

Data that pass the ECOTOX screen are evaluated along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. In general, effects data in the open literature that are more conservative than the registrant-submitted data are considered. The degree to which open literature data are quantitatively or qualitatively characterized for the effects determination is dependent on whether the information is relevant to the assessment endpoints (*i.e.*, maintenance of CRLF survival, reproduction, and growth) identified in Section 2.8. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are not available. Although the effects determination relies on endpoints that are relevant to the assessment endpoints of survival, growth, or reproduction, it is important to note that the full suite of sublethal endpoints potentially available in the effects literature (regardless of their significance to the assessment endpoints) are considered to define the action area for iprodione.

Citations of all open literature not considered as part of this assessment because they were either rejected by the ECOTOX screen or accepted by ECOTOX but not used (*e.g.*, the endpoint is less sensitive) are included in **Appendix G**. **Appendix G** also includes a rationale for rejection of those studies that did not pass the ECOTOX screen and those that were not evaluated as part of this endangered species risk assessment. A detailed spreadsheet of the available ECOTOX open literature data, including the full suite of lethal and sublethal endpoints is presented in **Appendix H**. Appendix I includes a summary of the human health effects data for iprodione.

In addition to registrant-submitted and open literature toxicity information, reviews of the Ecological Incident Information System (EIIS), are conducted to further refine the characterization of potential ecological effects associated with exposure to iprodione.

At this time, no toxicity data are available to characterize the effects of intermediate metabolites to non-target organisms. Therefore, it is assumed that data available for iprodione are representative of effects to non-target organisms that may be caused by these metabolites. Some open literature are available for 3,5-DCA, but it is assumed that this chemical has a different mode of action compared to iprodione.

A detailed summary of the available ecotoxicity information for iprodione TGAI (technical grade active ingredient) and formulated products containing iprodione is presented in **Appendix J**.

As discussed previously, iprodione has several registered products that contain multiple active ingredients. All but one of these products contain iprodione in combination with the fungicide thiophinate-methyl (CAS 23564-05-8). A single formulated product contained iprodione co-formulated with trifloxystrobin (CAS 141517-21-7). For the formulated products containing thiophanate-methyl, rat acute oral toxicity studies resulted in LD_{50} values ranging from 4199 to >5000 mg/kg bw. These values are relatively consistent with the rat acute oral LD_{50} value for the technical grade active ingredient (LD_{50}=4,468 mg/kg bw) discussed in Section 4.2.2. Based on these toxicity estimates, iprodione technical and its formulated products are classified as practically nontoxic to mammals on an acute oral exposure basis. No data were available with which to evaluate the toxicity of the formulated product containing trifloxystrobin.

4.1 Evaluation of Aquatic Ecotoxicity Studies

Table 26 summarizes the most sensitive aquatic toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature, as previously discussed. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the CRLF is presented below. Additional information is provided in **Appendix J.**

Table 26. Freshwater Aquatic Toxicity Profile for Iprodione.

Assessment Endpoint	Species (*scientific name*)	Toxicity Value Used in Risk Assessment	Describe effect (*i.e.* mortality, growth, reproduction)	Citation MRID # (Author & Date)	Study Classification
Acute Direct Toxicity to Aquatic-Phase CRLF	Channel Catfish *Ictalurus punctatus*	LC_{50} = 3,100 µg/L (Probit dose-response slope=10)**	Mortality	4702540-18 Swigert *et al*. 1986	Supplemental
Chronic Direct Toxicity to Aquatic-Phase CRLF	Fathead Minnow *Pimephales promelas*	NOAEC =260 µg/L	Reduced Larval Survival	405508-01 Suprenant 1988*a*	Acceptable
Indirect Toxicity to Aquatic-Phase CRLF via Acute Toxicity to Freshwater Invertebrates (*i.e.* prey items)	Waterflea *Daphnia magna*	EC_{50} = 240 µg/L (Probit dose-response slope=3.45)	Immobilization	416420-01 McNamara 1990	Supplemental*
Indirect Toxicity to Aquatic-Phase CRLF via Chronic Toxicity to Freshwater Invertebrates (*i.e.*	*D. magna*	NOAEC = 170 µg/L	Reduced Reproduction, Larval Survival, Growth	404892-01 Surprenant 1988*b*	Supplemental

prey items)					
Indirect Toxicity to Aquatic-Phase CRLF via Toxicity to Non-vascular Aquatic Plants	*Navicula pelliculosa*	EC_{50} =50 µg/L	Growth	416041-11 Giddings 1990	Supplemental
Indirect Toxicity to Aquatic-Phase CRLF via Toxicity to Vascular Aquatic Plants	*Lemna gibba*	EC_{50} >12,640 µg/L	Growth	457413-01 Sowig 2002	Supplemental

*study originally classified as invalid due to high control mortality; however, the study has been up-graded to supplemental.
**probit dose response slope estimated using the average of slopes for bluegill sunfish (11.8) and rainbow trout (8.2).

Toxicity to aquatic fish and invertebrates is categorized using the system shown in **Table 27 (**U.S. EPA, 2004). Toxicity categories for aquatic plants have not been defined.

Table 27. Categories of Acute Toxicity for Fish and Aquatic Invertebrates.

LC_{50} (ppm)	Toxicity Category
< 0.1	Very highly toxic
> 0.1 - 1	Highly toxic
> 1 - 10	Moderately toxic
> 10 - 100	Slightly toxic
> 100	Practically nontoxic

4.1.1 Toxicity to Freshwater Fish

Given that no iprodione toxicity data are available for aquatic-phase amphibians; freshwater fish data were used as a surrogate to estimate direct acute and chronic risks to the CRLF. Freshwater fish toxicity data were also used to assess potential indirect effects of iprodione to the CRLF. Effects to freshwater fish resulting from exposure to iprodione may indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

A summary of acute and chronic freshwater fish data, including data from the open literature, is provided below.

4.1.1.1 Freshwater Fish: Acute Exposure (Mortality) Studies

In a 96-hr flow-through study (Swigert *et al*. 1986) of channel catfish (*Ictalurus punctatus*), the NOAEC and LC_{50} are 0.52 and 3.1 mg a.i./L, respectively. Based on these data, iprodione is classified as moderately toxic to freshwater fish on an acute exposure basis. The study was classified as supplemental and as not having fulfilled guideline testing requirements for acute toxicity to freshwater fish because of solubility issues.

Other estimates of acute toxicity of iprodione are available for bluegill sunfish (*Lepomis macrochirus*; Sousa 1990*a*) and for rainbow trout (*Oncorhynchus mykiss*; Sousa 1990*b*). The 96-hr LC_{50} values for bluegill (3.7 mg a.i/L) and rainbow trout (4.1 mg a.i./L) are relatively consistent with the endpoint used in this assessment, *i.e,* 96-hr LC_{50}=3.1 mg a..i./L. Although the dose response curve for channel catfish did not provide a probit slope estimate, probit dose response slopes are available for bluegill (slope = 11.8) and rainbow trout (slope = 8.2); the mean of the two slope estimates is 10 (standard error: ±1.8).

All of these studies have been classified as not having fulfilled guideline testing requirements because measured concentrations were highly variable; higher test concentrations (typically >2.5 mg/L) used in these studies had precipitates that may have limited exposure to the test substance. Because of this issue, both the bluegill sunfish (Sousa 1990*a*) and the rainbow trout (Souse 1990*b*) studies were classified as invalid by the EPA reviewers. However, all of the studies had measured concentrations and represent less sensitive toxicity data for iprodione. While none of the studies fulfill guideline testing requirements, the results of these studies provide useful information for qualitatively describing the sensitivity of aquatic vertebrates to iprodione. It is possible that actual exposure concentrations, in terms of material that was biologically available, are lower than what is reported in these studies since the researchers did not centrifuge and/or filter water samples prior to measuring chemical concentrations. However, as stated previously, these data do represent the best available data for iprodione.

Formulated product testing with Rovral® 50 WP (50%ai) indicated that the product was less toxic (96-hr LC_{50}=7,800 mg ai/L; Surprenant1987) than the technical grade active ingredient.

No data were available in the open literature that were more sensitive than the endpoints provided through registrant-submitted data.

4.1.1.2 Freshwater Fish: Chronic Exposure (Early Life Stage and Reproduction) Studies

Based on an early life-stage study (Suprenant 1988*a*) of fathead minnow (*Pimephales promelas*), the NOAEC and LOAEC are 0.26 and 0.55 mg/L, respectively. The LOAEC is reportedly based on reductions in larval survival; however, the percent reduction is not reported. The study is classified as acceptable.

No data were available in the open literature that were more sensitive than the endpoints provided through registrant-submitted data.

4.1.2 Toxicity to Freshwater Invertebrates

Freshwater aquatic invertebrate toxicity data were used to assess potential indirect effects of iprodione to the CRLF. Effects to freshwater invertebrates resulting from exposure to iprodione may indirectly affect the CRLF via reduction in available food items. As discussed in Section 2.5.3, the main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic invertebrates found along the shoreline and on the water surface, including aquatic sowbugs, larval alderflies and water striders.

A summary of acute and chronic freshwater invertebrate data, including data published in the open literature, is provided below.

4.1.2.1 Freshwater Invertebrates: Acute Exposure (Mortality) Studies

In a 48-hr study with waterfleas (*Daphnia magna*; McNamara 1990), immobilization in the dilution water control and solvent control averaged 5 and l0%, respectively, which did not meet the guideline requirements and is classified as supplemental. The 48-hour EC_{50} was 0.24 mg a.i./L (240 µg/L) based on measured concentrations, therefore, iprodione is classified as highly toxic to daphnids on an acute exposure basis. The study did not fulfill guideline testing requirements due to high mortality in the control (5%) and solvent control (10%) and according to the EPA reviewer, the study did not establish a NOAEC. For the purposes of this assessment, the study has been upgraded to supplemental since current EFED policy states that control mortality should not exceed 10% and acute toxicity studies are not required to establish a NOAEC. Although not originally reported in the data evaluation record for the McNamara study, the probit dose-response is 3.45 and is based on a re-analysis of the raw data for the purposes of this assesssment.

Two additional studies of *D. magna* are available; one by Roberts (1977) reported a 48-hr static LC_{50} of 382 µg/L. The second study by Vilkas (1977) reports a 48-hr LC_{50} of 7200 µg/L for *D. magna*. Although the studies by McNamara (1990) and Roberts (1977) have relatively consistent toxicity estimates for *D. magna*, the study by Vilkas is an order of magnitude less sensitive.

In an acute toxicity study identified through ECOTOX, Beketov and Liess 2008 examined the effect of iprodione on blackfly larvae (*Simulium latigonium*), and the amphipod *(Gammarus pulex)*. The 96-hr LC_{50} values were 480 µg/L in *S. latigonium* and 3460 µg/L in *G. pulex*, both of which are less sensitive than *D. magna*. The study though relied on dimethylsulfoxide (DMSO) as a co-solvent and it is uncertain as to the extent that the co-solvent may have affected uptake of the iprodione.

4.1.2.2 Freshwater Invertebrates: Chronic Exposure (Reproduction) Studies

In a 21-day study of waterfleas (*D. magna*; Surprenant 1988*b*), the test concentrations varied substantially throughout the test period (*i.e.*, the highest measured concentration in three treatments was more than twice the lowest in the same concentration). Raw data (biological, physical, and chemical) were not submitted with the report, therefore, the reviewer could not verify the author's results. However, based on the study results, the NOAEC=0.17 mg/L (170 µg/L) and the LOAEC=0.33 mg/L based on reductions in survival (26%), growth (mean body length; 7%) and number of young per female (38%). The study is classified as supplemental and did not fulfill guideline testing requirements.

ECOTOX identified a study by Beketov and Liess 2008 in which iprodione treatment was observed to significantly affect (increase) the maximum observed percentage of drifted *G. pulex*. According to the study, increased drift was detected within 2 hrs after treatment. Maximum drift percentages were detected 4 hrs after treatment initiation. During subsequent observation periods (22–48 hrs after treatment was initiated) the drift responses became less pronounced. Peak drift was initiated at iprodione concentrations of 366 µg/L; this concentration is roughly 9.5 times lower than the 96-hr LC_{50} value for iprodione (3460 µg/L) in *G. pulex*. The effect concentration reported in this study is less sensitive than that for *D. magna*. Also, there is uncertainty regarding how DMSO may have affected iprodione uptake.

4.1.3 Toxicity to Aquatic Plants

Aquatic plant toxicity studies were used as one of the measures of effect to evaluate whether iprodione may affect primary production and the availability of aquatic plants as food for CRLF tadpoles. Primary productivity is essential for indirectly supporting the growth and abundance of the CRLF.

Two types of studies were used to evaluate the potential of iprodione to affect aquatic plants. Laboratory and field studies were used to determine whether iprodione may cause direct effects to aquatic plants. A summary of the laboratory data for aquatic plants is provided in Section 4.1.3.1.

4.1.3.1 Aquatic Plants: Laboratory Data

In a 5-day study (Giddings 1990*c*) of the freshwater diatom *Navicula pelliculosa* based on initial measured concentrations, the 120-hour NOAEC, LOAEC, and EC_{50} for *Navicula* exposed to iprodione were 13, 20, and 50 µg ai/l, respectively. The study is classified as core.

Toxicity data for other aquatic plants include studies on the estuarine/marine diatom (*Skeletonema costatum* 120-hr EC_{50}=330 µg/L; Giddings 1990*a*), green algae

(*Pseudokirchneriella subcapitata* formerly *Selenastrum capricornutum* 120-hr EC_{50}=1,800 µg/L; Giddings 1990*d*) and cyanobacteria (*Anabaena flos-aquae* 120-hr EC_{50}>860 µg/L; Giddings 1990*e*). Compared to the most sensitive toxicity estimate for aquatic plants, *i.e*., *Navicula* EC_{50}=50 µg/L, the remaining nonvascular plants are relatively insensitive to iprodione.

In a 7-day acute toxicity study (Sowig 2002) with the aquatic vascular plant duckweed (*Lemna gibba*), the median effect concentration exceeded the highest concentration tested, *i.e*, EC_{50}>12.6 mg/L for number of fronds, plant biomass and growth rate. The NOAEC for all three measurement endpoints was 12.6 mg/L. The study is classified as supplemental because of solubility issues associated with the test material.

ECOTOX identified a study by Ma *et al*. 2002 examining the effects of various pesticides, including iprodione, on two types of green algae (*Chlorella pyrenoidosa* and *Scenedesmus obliqnus*). Estimated EC_{50} values for *C. pyrenoidosa* and S. obliqnus are 6.05 mg/L. and 41.9 mg/L, respectively. Both of these values though are less sensitive than what has been obtained from registrant-submitted studies.

4.2 Toxicity of Iprodione to Terrestrial Organisms

Table 28 summarizes the most sensitive terrestrial toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the CRLF is presented below.

Table 28. Terrestrial Toxicity Profile for Iprodione.

Assessment Endpoint	Species (*scientific name*)	Toxicity Value Used in Risk Assessment	Describe effect (i.e. mortality, growth, reproduction)	Citation MRID # (Author & Date)	Study Classification
Acute Dose-based Direct Toxicity to Terrestrial-Phase CRLF	Northern bobwhite quail (*Colinus virginianus*)	LD_{50} =930 mg/kg	Mortality	Acc# 232703 McGinnis and Johnson 1973	Core
Acute Dietary-based Direct Toxicity to Terrestrial-Phase CRLF	Northern Bobwhite Quail	LC_{50} >5,620 mg/kg diet	Mortality	416041-02 Driscoll *et al*. 1990	Core
Chronic Direct Toxicity to Terrestrial-Phase CRLF	Northern Bobwhite Quail	NOAEL = 324 mg/kg diet	Reduced number of eggs laid; reduced hatchling body weight.	Acc# 00099126 Fink *et al*. 1981*a*.	Core
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to mammalian prey items)	Laboratory Rat (*Rattus norvegicus*)	LD_{50} =4,468 mg/kg bw	Mortality	423063-01 Cummins	Acceptable
Indirect Toxicity to Terrestrial-Phase CRLF (via chronic toxicity to mammalian prey items)	Laboratory Rat	NOAEL=300 mg/kg-diet (18.5 mg/kg/day)	Decreased body weight, body weight gain and decreased food consumption	00162983 41871601 Henwood 1991	Acceptable
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to terrestrial invertebrate prey items)	Honey bee (*Apis mellifera*)	LD_{50} >120 µg/bee	Mortality	442620-61 Atkins 1975	Acceptable

Acute toxicity to terrestrial animals is categorized using the classification system shown in **Table 29** (U.S. EPA, 2004). Toxicity categories for terrestrial plants have not been defined.

Table 29. Categories of Acute Toxicity for Avian and Mammalian Studies.

Toxicity Category	Oral LD_{50}	Dietary LC_{50}
Very highly toxic	< 10 mg/kg	< 50 ppm
Highly toxic	10 - 50 mg/kg	50 - 500 ppm
Moderately toxic	51 - 500 mg/kg	501 - 1000 ppm
Slightly toxic	501 - 2000 mg/kg	1001 - 5000 ppm
Practically non-toxic	> 2000 mg/kg	> 5000 ppm

4.2.1 Toxicity to Birds

As specified in the Overview Document, the Agency uses birds as a surrogate for terrestrial-phase amphibians when amphibian toxicity data are not available (U.S. EPA, 2004). No terrestrial-phase amphibian data are available for iprodione; therefore, acute and chronic avian toxicity data are used to assess the potential direct effects of iprodione to terrestrial-phase CRLFs.

4.2.1.1 Birds: Acute Exposure (Mortality) Studies

In an acute oral toxicity study (McGinnis and Johnson 1973) with Northern bobwhite quail (*Colinus virginianus*) and based on nominal oral doses, the LD_{50} was 930 mg a.i./kg. No sublethal effects were reported in the study. Based on the results of this study, iprodione is classified as slightly toxic to Northern bobwhite quail. The study is classified as acceptable and fulfills the guideline test requirements of an avian single oral dose LD_{50} test.

Another more recent study with Northern bobwhite quail resulted in an acute oral LD_{50} value exceeded the highest concentration tested, *i.e.*, 2000 mg/kg bw, and where no mortality was observed in any of the treatment groups (Culotta *et al*. 1990). The more recent acute oral toxicity study by Culotta *et al*. (1990) is more consistent with the available subacute dietary toxicity studies discussed below indicating that iprodione is practically nontoxic to birds on a subacute dietary exposure basis.

In a subacute dietary toxicity study with Northern bobwhite quail (*C. virginianus*; Driscoll *et al*. 1990) and based upon nominal exposure concentrations, the dietary LC_{50} of iprodione was greater than 5,620 mg/kg diet, the highest dietary concentration tested. This value classifies iprodione as practically non-toxic to upland game birds. There was no effect on body weight and or mortality in the study; as such, the NOAEC is 5620 mg/kg diet. The study is classified as acceptable. Similar results were obtained in a subacute dietary toxicity study with mallard ducks (*Anas platyrhyncos*; Driscoll *et al*. 1990*b*). The subacute dietary toxicity studies for Northern bobwhite quail (Driscoll *et al.* 1990*a*) and for mallard ducks (Driscoll *et al*. 1990*b*) both resulted in LC_{50} values greater than the highest concentration tested, *i.e.*, 5,620 mg/kg diet. In the quail study, 2 birds were dead in the 5,620 mg/kg diet group while in the mallard study none of the birds died. The quail study did report dose-depended effects on body weight but no effect on feed consumption. At the highest treatment level, *i.e.*, 5620 mg/kg diet, average body weight was roughly 33% less than controls. Although none of the birds in the mallard study died, body weights appeared to be affected similar to what was observed in the quail study; mallards at the highest treatment level, *i.e.*, 5620 mg/kg diet, had average body weights roughly 26% lower than controls.

One study was available in the open literature on the effects of iprodione on liver enzyme production in Japanese quail (*Coturnix coturnix*) (Riviere *et al.* 1983) following sub-acute dietary exposure at 2000 ppm for 7 days. In the iprodione-treated birds, liver weights were not significantly different than controls; however, cytocrhome P450 activity was roughly 4 times greater than controls. Activity of 7-ethoxyresorufin dealkylase was 12 times greater than controls; however, there were no reports of mortality in the treated birds. While there were sublethal impacts on enzyme activity these effects are not linked to more apical endpoints.

4.2.1.2 Birds: Chronic Exposure (Growth, Reproduction) Studies

In a avian reproduction study with Northern bobwhite quail (Fink *et al*. 1981*a*.), reproduction was adversely affected by exposure at the 941 mg ai/kg diet level. Specifically, the study authors' analysis detected a statistically-significant ($p<0.05$) reduction in the percentage of eggs laid of maximum laid (39% versus 51% for the control) and in the mean body weight of hatchlings (6.0 g versus 6.3 g for the control). Both the reviewer and study authors detected a statistically-significant ($p<0.05$) reduction in the percentage of normal hatchlings of eggs set at the 941 mg ai/kg diet level (41% versus 56% for the controls) and the reviewer's analysis additionally detected a significant reduction ($p=0.009$; 19% of control) at the same level in the proportion of number hatched to live 3-week embryos (Fink *et al*. 1981*b*). Based on the results of this study, the NOAEL and LOAEL are 324 and 941 mg/kg diet, respectively.

No chronic avian toxicity data were identified in the open literature that were more sensitive than the registrant-submitted data discussed above.

4.2.1.3 Terrestrial-phase Amphibian Acute and Chronic Studies

No data are available on the toxicity of iprodione to terrestrial-phase amphibians.

4.2.2 Toxicity to Mammals

Mammalian toxicity data are used to assess potential indirect effects of iprodione to the terrestrial-phase CRLF. Effects to small mammals resulting from exposure to iprodione may also indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

The Health Effects Division (HED) risk assessment for iprodione (USEPA 1998*c*) concluded that the chemical is associated with toxicity of the liver, adrenals and male and female reproductive organs with the proposed mode of action as the disruption of testosterone biosynthesis. Iprodione is also associated with tumors in these organ systems and the compound is classified as B2 carcinogen given the compound's ability to cause Leydig cell tumors.

4.2.2.1 Mammals: Acute Exposure (Mortality) Studies

According to the HED mammalian risk assessment (U.S. EPA 1998*c*), the acute oral toxicity of iprodione to the rat is 4468 mg/kg bw (Chambers *et al*. 1992). As such, iprodione is classified as practically nontoxic to mammals on an acute oral exposure basis.

As discussed previously, rat acute oral toxicity data are available for the formulated products of iprodione containing thiophanate-methyl. The LD_{50} values for the formulated products ranged from 4,199 to >5,000 mg/kg bw. As such the formulated products evaluated are classified as practically nontoxic to mammals on a acute exposure basis.

ECOTOX also identified a study on rats by Rankin *et al.* 1984. examining the nephrotoxic properties of three fungicides, including iprodione, in male rats. No significant renal effects were found to result from single doses ranging from 0.4 and 1.0 mmol/kg (114 - 286 mg/kg bw). However, the study contains a significant solvent effect in controls and was potentially confounded by this effect.

4.2.2.2 Mammals: Chronic Exposure (Growth, Reproduction) Studies

In a 2-generation rat reproduction study where animals were exposed via the diet at dose levels of 0, 300, 1000 and 2000 ppm, the systemic NOAEL was 300 ppm (18.5 mg/kg/day for two generations and the LOAEL was 1000 ppm (61.4 mg/kg/day) based on decreased body weight, body weight gain and decreased food consumption. The reproductivie [offspring] NOAEL was 1000 ppm (76.2 mg/kg/day) and the LOAEL was 2000 ppm (201.2 mg/kg/day) based on decreased pup viability [as evidenced by an increased number of stillborn pups and decreased survival during postnatal days 0 - 4, and decreased pup body weight throughout lactation (USEA 1998b). For the purposes of this assessment, the systemic NOAEL of 300 ppm (18.5 mg/kg/day) will be used to estimate risk.

According to the iprodione RED (USEPA 1998b), iprodione is classified as a Group B2, *i.e.*, it is considered a "likely" carcinogen, based on evidence of tumors in both sexes of mouse [hepatocellular adenoma/carcinoma] and in the male rat [Leydig cell].

In a study identified through ECOTOX by Gray *et al.* 1999 examining the effects of iprodione (100 mg/kg/day) administered by gavage to 14-day old rats through post-natal day 3, 5-month old male offspring did not exhibit any statistically significant. abnormalities associated with hermaphrodism, de-masculination, and/or growth.

4.2.3 Toxicity to Terrestrial Invertebrates

Terrestrial invertebrate toxicity data are used to assess potential indirect effects of iprodione to the terrestrial-phase CRLF. Effects to terrestrial invertebrates resulting from exposure to iprodione may also indirectly affect the CRLF via reduction in available food.

4.2.3.1 Terrestrial Invertebrates: Acute Exposure (Mortality) Studies

Iprodione is classified as practically nontoxic to honeybees (*Apis mellifera*) on an acute contact exposure basis with an LD_{50} value of greater than 120 μg/bee. No bee mortality was reported at the highest dose tested.

Studies were also identified in ECOTOX. Ladurner *et al*. 2005 examined the effects of formulated iprodione (Rovral) on two bee species (*Osmia lingaria* and *Apis mellifera*). For both bee species, delayed (7-day post-treatment) survival rates after oral and contact exposure to single high dose of iprodione at 125 µg a.i./bee were not statistically different ($p>0.05$) to those in the control. However, Huntzinger *et al.* 2008 examined the effects of formulated iprodione (Rovral® 50 WP) and other fungicides on adult leafcutter bee (*Megachile rotundata*) via three different exposure methods. The study found that contact and oral dosing reduced bee survival while topical exposure did not. Contact treatment showed a significant reduction in survival in males at 30 mg a.i over the 20-day study period. Bees exposed orally to 5 µg a.i./ µL also exhibited significant reductions in survival relative to controls. Because of uncertainty regarding actual exposure levels in the oral toxicity study, this Huntzinger study provides only qualitative information on the potential effects of iprodione on bees; given the time frame over which the Huntziner *et al* 2008 study examines effects, it may be more representative of effects on chronic survival rather than acute mortality. The study only provides qualitative evidence of potential effects though since exposure was not well characterized in the study.

Although ECOTOX identified a study by Pekár (2002) on spiders (*Theridion impressum*) as providing useful information, the study was considered unsound for inclusion in this risk assessment since exposure was not adequately characterized.

In a study by DeNardo *et al*. 2003, formulated iprodione (Chipco 26GT 23.3% a.i.) at a rate equivalent to the maximum label rate, did not have a statistically significant effect on nematode (*Steinernema feltiae*) survival and/or infectivity under the conditions tested. This study was essentially an efficacy study and provided qualitative information that the formulated product was not toxic to the soil nematode. Additionally, Hautier *et al*. 2005 examined the effects of formulated iprodione (Robral WG) applied at a rate equivalent to 750 g ai./ha on adult parasitic wasps *Aphidius rhopalosiphi*, adult carabid beetles *Bembidion lamprosm*, adult rove beetles *Aleochara blilineata*, larval ladybird beetles *Adalia bipunctata*, and larval hoverflies *Episyrphus balteatus.* Organims were exposed either for 48 hrs or for 2 wks. Under the conditions tested, no significant effects were noted for any of the species. In a study by Helyer with the predatory midge *Aphidoletes aphidimyza* exposure to formulated iprodione (Rovral WP) at a contact level of 500 mg a.i for 48 hours resulted in less than 15% mortality in adults, less than 5% mortality in eggs and no mortality in larvae (1st instar).

4.2.3.2 Terrestrial Invertebrates: Chronic Exposure (Growth, Reproduction) Studies

Although not typically evaluated in ecological risk assessments, there are data suggesting that iprodione exposure may result in effects on honeybee brood development. In an unpublished manuscript by Mussen *et al.* 2008 submitted as an incident report, the authors describe the effects of Rovral® on honeybee larvae fed at a rate equivalent to 0.5 µg/bee. This rate was based on estimated exposures to honeybees given the label application rate to almonds of 0.561 kg/ha (0.5 lbs/Acre). In addition to increased mortality of larvae, abnormal morphological development in worker pupae was observed. The authors concluded that adult forage bees could bring compounds such as iprodione back to the hive where it could be mixed into larval diet and interfere with larval and pupal development. The data indicate that the formulated product of iprodione is more toxic to honeybee larvae than adult honeybees; however, there were insufficient data to determine whether the increased toxicity of the formulated product to honeybees was due to iprodione, the inerts, or the combination of the two.

Iprodione has been measured in wax samples collected from bee colonies; mean iprodione residue levels in wax were 48.9±21µg/kg (vanEnglesdorp *et al.* 2009). In unpublished data, Pennsylvania State University researchers have analyzed wax from 208 samples collected from commercial bee colonies; 6.7% of the wax samples contained iprodione residues with maximum iprodione residues of 636 µg/kg (personal communication: Dr. Chris Mullin, Department of Entomology, Pennsylvania State University, September 2, 2009). These data indicate that iprodione is detected in honeybee colonies where it can potentially affect brood development.

Although ECOTOX identified a study by Dernoeden *et al*. 1990 as providing useful information on the effects of iprodione on nematodes in bluegrass and ryegrass, the study site had been treated with multiple pesticides and because of the potential confounding effects of the mixture, the study was not considered in this assessment.

ECOTOX also identified a study by Goettel *et al*. 1991 examining the effects of prophylactic formulated iprodione (Rovral 50 WP) application in leafcutter bees (*Megachile rotundata*). The fungicide was incorporated into the natural provisions of the bee larvae and the effects of the fungicide on growth, mortality and the incidence of fungal disease chalkbrood (*Ascosphaera aggregate*) were determined. Under the conditions tested, the exposure of developing larvae to Rovral 50 WP resulted in significantly ($p<0.01$) increased mortality at time of defication and at cocoon completion, prolonged development time to defication relative to untreated controls; based on mortality and developmental effects, the NOAEC is 100 ppm and the LOAEC is 1000 ppm. There was significant uncertainty in this study since the percentage of active ingredient tested is not specified. As such, this study can only be used qualitatively, but it supports the concern regarding the potential for adverse effects from exposure of bees to iprodione and that the effects are not limited to honeybees. Finally, in a study by Schwartz 1991, the acute effects of formulated iprodione were examined on predatory mites *Ablyseius addoensis*; however, exposure to either liquid (0.2 mL/L) or dust formulation of iprodione resulted in less than 0.1% mortality after 24 hours.

4.2.4 Toxicity to Terrestrial Plants

Terrestrial plant toxicity data are used to evaluate the potential for iprodione to affect riparian zone and upland vegetation within the action area for the CRLF. Impacts to riparian and upland (*i.e*., grassland, woodland) vegetation may result in indirect effects to both aquatic- and terrestrial-phase CRLFs, as well as modification to designated critical habitat PCEs via increased sedimentation, alteration in water quality, and reduction in of upland and riparian habitat that provides shelter, foraging, predator avoidance and dispersal for juvenile and adult CRLFs.

No registrant-submitted terrestrial plant toxicity studies are available for iprodione. Toxicity studies with terrestrial plants were identified through ECOTOX and are reviewed briefly below. However, none of the studies provide information that can be used quantitatively in this assessment. All of the studies were limited by poorly characterized exposure conditions. While there were conflicting reports in the open literature on the potential effects of iprodione on terrestrial plants, the weight-of-evidence collected through the open literature combined with available incident data suggests that iprodione exposure can result in effects on terrestrial plants.

In a study by Morale and Kurundkar 1989, formulated iprodione (Rovral 50 WP) was applied at a rate of 0.1% to eggplants (*Solanum melongena)* and the plants were evaluated 45 days post-treatment. According to the study, iprodione treatment resulted in significant increases in leaf area per plant, dry root weight and dry shoot weight.

Gange *et al.* 1992 provides qualitative information that although formulated iprodione (Rovral) did not affect seed germination in many of the species on which it was tested, it did significantly reduce seed germination of the perennial forb English plantain, *Plantago lanceolata* at a treatment rate that was considered representative of a field application rate.

Benson *et al.* 1992 examined the effects of formulated iprodione (Chipco® 26019 50W) on root formation and growth of poinsettias (*Euphorbia pulcherrima*) plants. The study examined two different application methods (spraying and rooting cube soaking) and found that plant height and root initiation were affected by iprodione spraying while only root initiation was affected by rooting cube soaking. However, in a previous study by Benson (1991), he reports no significant effect of iprodione on poinsettias growth at the same exposure concentrations.

Gadeva and Dimitrov 2008 examined the genotoxicity of several pesticides including iprodione in the terrestrial plant smooth hawk's beard *Crepis capillaris*. The study found that formulated iprodione (Rovral 25 Flo) may act as a aneugen *in vitro*, *i.e*., affects cell division and the mitotic spindle apparatus resulting in the loss or gain of whole chromosomes inducing an aneuploidy, but that iprodione does not impact meristem growth or cell proliferation. As an in vitro study, it is unclear how this endpoint may related to effects in the field.

Yi *et al*. 2003 examined the effects of iproidone and other fungicides on tubule germination and tubule morphology in almond (*Prunis dulcis*) pollen. At 10% and 1% of the recommended field rate (RFR) 11.2 and 62.9%, respectively, of the iprodione-treated pollen germinated. As such, all of the iprodione treatments significantly ($p=0.05$) affected pollen germination. Pollen tube length was also significantly affected by iprodione treatment at both the 100% and 10% of RFR treatments. At the 100% RFR, no pollen germinated and as such there were no tubules; in the 10% RFR, the length of tubules was roughly 60% less than controls. However, in another study by Yi *et al*. 2003 examining the effects of formulated iprodione (Rovral) on almond pollen, treatment rates of 1.2 g/L intended to represent a field application rate of 1.12 kg/ha to almond buds, iprodione had no significant ($p>0.05$) effect on pollen tube number or on maximum tube length.

Rouchard *et al.* 1984 demonstrated that iprodione significantly affected (increased) growth of lettuce (*Lactuca sativa*) over a 32-day post-treatment period. Formulated iprodione (Rovral) at a rate of 50 g/acre appeared to significantly increase pigment content in leaves and plant weight relative to controls.

St. Claire *et al*. 2005 examined the effects of formulated iprodione (Rovral) on mycorrhizal associations with sugar maple (*Acer saccharum*) and then correlated that association with photosynthetic production. The study focused on the efficacy of iprodione in controlling fungal infection; however, it does provide qualitative information that iprodione treatment at a rate of 2 g/m^2 significantly affected calcium uptake; iprodione-treated seedlings accumulating less foliar calcium than controls. It is uncertain though how this effect relates to the overall functioning of the sugar maple plants.

Enwistle *et al.* 1981 examined the effects of formulated iprodione (Rovral® 50% WP) on the germination of salad onion (*Allium fistulosum)* seeds. According to the study, at 100 g/kg seed treatment level, iprodione did not affect the time at which seeds started to germinate but caused a 7 - 24% reduction in final germination and a small but inconsistent increase in the number of abnormal seedlings. Iprodione seed treatment consistently increased time to 50% generation by up to roughly 3 days. Iprodione had no effect on the time at which seedlings started to emerge but there was a significant albeit inconsistent increase in the final percentage.

West *et al*. 1993 examined the effects of various fungicides, including iprodione, on mycorrhizal colonization in the roots of winter annual grass *Vulpia ciliata* ssp. *ambigua.* Formulated iprodione was applied to plants using the formulated product Rovral® at a rate of 0.6 g/m^2. Although this study primarily focuses on the efficacy of various fungicides in controlling root fungus, it measures the effect of iprodione indirectly through an analysis of covariance. The analysis suggests that when the effects of fungal infection are removed, iprodione appears to significantly ($p<0.05$) affect (reduce) shoot mass and leaf mass.

Wick and Philp 1985 examined the effects of iprodione on the emergence and growth of two onion (*Allium cepa*) cultivars: White Spanish and Goldberg. Iprodione was dosed using an undisclosed commercial formulation stated to be 50% w.p. at 50, 100, 200 and 400 g product/kg seed. At the seed treatment levels tested, iprodione resulted in significantly ($p<0.05$) reduced emergence in both cultivars of onions. Hypocotyl and radicle growth of both cultivars were also significantly reduced. Iprodione treatment significantly ($p<0.05$) reduced field emergence in the Goldberg cultivar at all of the seed treatment rates tested, but did not reduce emergence at any of the treatment rates for the White Spanish cultivar. Plant height was only significantly reduced at the highest concentration.

While there were studies demonstrating the potential effect of iprodione on terrestrial plants, there were two studies showing that iprodione treatment had not apparent effect on plants. In a 3-yr study of bentgrass (*Agrostis palustris*) by Reicher and Throssell 1997 mean clipping weight, carbohydrate concentration of clippings, rooting, mean disease incidence, earthworm casts, or thatch of plots of creeping bentgrass were not significantly affected ($p>0.05$) by weekly iprodione treatments at rates equivalent to 3.05 kg/ha. Additionally, Gullino *et al* 1994 demonstrated that formulated iprodione (EXP 1861) soil drench treatments at 1 - 4 g/m^2 did not appear to significantly affect percent emergence or basil (*Ocymum basilicum*) fresh weight. Additionally, Olein *et al*. 1995 examined the synergistic effects of fungicides and the fertilizer ammonium thiosulphate (ATS) on peach trees (*Prunus persica*) where iprodione was applied as Rovral 4F (2.5 mL/L) at a rate of 1.58 kg a.i./ha. Although the study was primarily intended to measure the efficacy of iprodione alone and in combination with ATS, it provided qualitative information that at the application rate tested, iprodione did not affect the number of burned shoots per tree.

Although ECOTOX identified a study by Jeffers 1989, the study essentially examines efficacy at controlling cottonball disease (*Monilinia oxycocci*) in cranberry plants and did not provide information on the potential effects of iprodione on the plants themselves.

4.3 Toxicity of the 3,5-DCA Degradate

Several studies were identified in the open literature for 3,5-DCA. The only data available for fish in the open literature was a 14-day LC_{50} value of 3900 μg/L for guppies (*Poecilia reticulate*) (Maas-Diepeveen and van Leeuwen 1986). These data suggest that guppies are considerably less sensitive to the 3,5-DCA degradate than other species tested against the parent compound. Channel catfish exposed to iprodione had an LC_{50} of 3100 μg/L after 4 days of treatment compared to the LC_{50} of 3900 μg/L for guppies after exposure to the degradate for roughly 3.5 times longer.

In a 48-hr study with waterfleas (*D. magna*) the EC_{50} was 1120 μg/L (Maas-Diepeveen and van Leeuwen 1986) and is roughly 5 times less sensitive than the equivalent toxicity endpoint for waterfleas using the parent compound (48-hr EC_{50}=240 μg/L). A 96-hr study of 3,5-DCA with shrimp (*Crangon septemspinosa*) resulted in an LC_{50} value of 2500 µg/L (McLeese *et al.* 1979) and is considerably less toxic than the parent compound. Finally, in a 96-hr study with green algae (*Chlorella pyrenoidosa*), the EC_{50} was 7500 µg/L (*Maas-Diepeveen and van Leeuwen 1986*) and is four times less toxic than the estimate for green algae tested with the parent compound (96-hr EC_{50} =1800 µg/L) and is roughly 33 times less toxic than the most sensitive toxicity estimate for nonvascular plants (*N. pellicula* 96-hr EC_{50}=55 µg/L) tested with the parent compound. Therefore, based on the weight of evidence provided through the use of (Q)SARs and toxicity values reported in the open literature, 3,5-DCA is considered at least 4 times less toxic to aquatic organisms than the parent compound. Based on measured and estimated toxicity values for 3,5-DCA, the compound would be classified as moderately toxic to aquatic animals on an acute exposure basis.

Lo *et al.* 1994 reported the acute effects of 3,5-DCA in male Fisher rats (*R. norvegicus*). The study examined the acute effects of changes in chemical form and dosing method of 3,5-DCA on nephrotoxicity in rats and focused on the hydrochloride salt and free base forms of 3,5-DCA. Different administration methods (oral [*po*] and interperitonial injection [*ip*]) were also examined along with different carriers. These carriers included 0.9% saline solution, sesame oil, and 25% DMSO in 0.9% saline solution; only the *ip* injections relied on DMSO as one of the carriers. Rats were dosed *ip* with 0.8 mmol 3,5-DCA/ kg (264 mg/kg) while *po* injections were 1.5 mmol/kg (495 mg/kg). Although some effects on the kidneys were observed, there was no acute mortality due to 3,5-DCA after 48 hours except in the group treated where DMSO was used as a co-solvent. For treatments with DMSO, there was complete mortality. These results underscore the concern regarding the selection of co-solvents in toxicity studies and how DMSO can alter uptake. These study results are consistent with the understanding that iprodione and presumably its 3,5-DCA is not acutely toxic to mammals on an acute oral exposure basis though. The relevancy of the effects of DMSO on the *ip* study to this risk assessment is uncertain.

A single chronic toxicity value for 3,5-DCA is available through the open literature in which zebrafish (*Brachydario rerio*) were exposed for 28 days and resulted in a NOAEC of 1000 µg/L (1 mg/L) (van Leeuwen *et al*. 1990) based on survival, hatching and growth. Analytical measurements for 3,5-DCA were highly uncertain in the study and the extent of the effect on survival, hatching and growth is not discussed. No invertebrate chronic toxicity data were available from the open literature for 3,5-DCA. With an measured NOAEC of 1000 µg/L, 3,5_DCA is less toxic on a chronic exposure basis compared to the most sensitive chronic toxicity estimate for the parent, *i.e*., fathead minnow NOAEC=60 µg/L.

4.4 Endocrine Disruption

Although the EPA has developed a process for determining whether a chemical acts on endocrine-mediated processes, the Tier I tests of the Endocrine Disruption Screening Program are only just being implemented. According to the RED document (USEPA 1998*b*) for iprodione, the registrant (Rhone-Poulenc) at the time the RED document was written proposed that the mode of action for the production of Leydig cell tumors was the disruption of testosterone biosynthesis. Based on HED's assessment, iprodione and its metabolites appear to modulate Leydig cell steroidogenesis by interfering at the level of cholesterol transport and/or steroidogenic enzyme activity (USEPA 1998*b*).

4.5 Incident Database Review

A review of the EIIS database for ecological incidents involving iprodione was completed on August 31, 2009. The results of this review for terrestrial animal, plant, and aquatic incidents are discussed below in Sections 4.5.1 through 4.5.3, respectively. A complete list of the incidents involving iprodione including associated uncertainties is included as **Appendix K**. The Avian Incident Monitoring System (AIMS; American Bird Conservancy 2009) was also reviewed on August 31, 2009, and a single incident was reported associated with the use of iprodione on a golf course in Virginia. No incident reports were available for 3,5-DCA.

A total of 19 incidents are reported in the Ecological Incident Information System. Fourteen of the incidents are from iprodione use on blueberries; except for one incident in Mississippi, the remainder of the incidents involving blueberries occurred in Georgia. The nature of the damage to blueberries was not specified in the incident report. Two incidents were associated with the use of iprodione on turf (golf courses), one in Louisiana and the other in Virginia. One incident was associated with the use of iprodione on ornamental plants in Oregon and one incident was associated with an unspecified agricultural use of iprodione in California.

4.5.1 Terrestrial Animal Incidents

Application of iprodione to an unspecified agricultural area in California (IO 20302-002) resulted in the death of an unspecified number of honeybees. The incident report included an unpublished manuscript by Mussen et al. 2008 describing the adverse effects of Rovral® on honeybee brood development. The certainty of the beekill incident being related to iprodione is classified as "probable".

Application of iprodione to golf course turf (B000177-001) in Arlington, Virginia, in 1992 resulted in the death of a single bluebird (*Turdidae* sp.). The legality of the use is not reported and the certainty of it being related to iprodione is classified as "unlikely". This incident is also captured in the Avian Incident Monitoring System (AIMS; American Bird Conservancy 2009) where it reports that chlorpyrifos and metalaxyl were also in use at the time. Given that chlorpyrifos is considerably more toxic to birds than iprodione on an acute oral and subacute dietary exposure basis, the likelihood that the death of the bluebird resulted from iprodione is considered low.

4.5.2 Plant Incidents

A total of 15 incidents associated with the use of iprodione resulted in effects on terrestrial plants. The majority (14) of these incidents were from the use of iprodione on blueberries; of these, 8 of the incidents (IO4027-101, IO4027-001, IO4027-009, IO4027-013, IO4027-011, IO4027-008, IO4027-002, IO4027-012) took place in Bacon County, Georgia, 3 (IO4027-003, IO4027-014 and IO4027-005) occurred in Clinch County, Georgia, 1 (IO4027-007) in Coffee County, Georgia, 1 (IO4027-006) in Ware County, Georgia and 1 (IO4027-004) in Stone County, Mississippi. All of the incidents involving blueberries occurred from a registered use of iprodione and have a certainty index that iprodione was the cause of the index as “highly probable”. All of the incidents involving blueberries resulted in damage to the blueberries plants due to their direct treatment with iprodione; the extent of damage ranged from 0.26 to 80 acres affected. It is noteworthy that 10 of the incidents (IO4027-002, IO4027-010, IO4027-008, IO4027-001, IO4027-009, IO4027-006, IO4027-011, IO4027-003, IO4027-012 and IO4027-007) associated with blueberries in Georgia occurred on the same date, *i.e.*, April 7, 2003, and two additional incidents occurred on subsequent days, *i.e.*, incident IO14027-13 on April 17 and incident IO4027-005 on April 18, in 2003.

An incident (IO13636-027) involving ornamental plants in Washington County, Oregon, resulted in damage to 6 acres of tulips following direct application of iprodione on February 4, 2002.

4.5.3 Aquatic Animal Incidents

Only a single aquatic incident is reported in the EIIS associated with the registered use of iprodione on golf course turf (I000910-001) in St. John the Baptist Parish, Louisiana, on June 7, 1992. The incident involved the death of an unspecified number of golden shiners (*Notemigonus crysoleucas*), catfish (Ictaluridae), needlefish (*Strongylura exilis*), minnows (Cyprinidae), perch (Percida) and sunfish (Centrarchidae) due to runoff. The certainty of the incident being related to the application of iprodione to the golf course is classified as “possible”.

5.0 Risk Characterization

Risk characterization is the integration of the exposure and effects characterizations. Risk characterization is used to determine the potential for direct and/or indirect effects to the CRLF or for modification to its designated critical habitat from the use of iprodione in California. The risk characterization provides an estimation (Section 5.1) and a description (Section 5.2) of the likelihood of adverse effects; articulates risk assessment assumptions, limitations, and uncertainties; and synthesizes an overall conclusion regarding the likelihood of adverse effects to the CRLF or its designated critical habitat (*i.e.*, “no effect,” “likely to adversely affect,” or “may affect, but not likely to adversely affect”).

5.1 Risk Estimation

Risk is estimated by calculating the ratio of exposure to toxicity. This ratio is the risk quotient (RQ), which is then compared to pre-established acute and chronic levels of concern (LOCs) for each category evaluated (**Appendix D**). For acute exposures to the CRLF and its animal prey in aquatic habitats, as well as terrestrial invertebrates, the LOC is 0.05. For acute exposures to the CRLF and mammals, the LOC is 0.1. The LOC for chronic exposures to CRLF and its prey, as well as acute exposures to plants is 1.0.

Risk to the aquatic-phase CRLF is estimated by calculating the ratio of exposure to toxicity using 1-in-10 year EECs based on the label-recommended iprodione usage scenarios and the appropriate aquatic toxicity endpoint from **Table 26**. Risks to the terrestrial-phase CRLF and its prey (*e.g*. terrestrial insects, small mammals and terrestrial-phase frogs) are estimated based on EECs resulting from applications of iprodione and the appropriate toxicity endpoint from **Table 28**.

5.1.1 Exposures in the Aquatic Habitat

5.1.1.1 Direct Effects to Aquatic-Phase CRLF

Direct effects to the aquatic-phase CRLF are based on peak EECs for iprodione residues of concern in the standard pond and the lowest acute toxicity value for freshwater fish. In order to assess direct chronic risks to the CRLF, 60-day EECs and the lowest chronic toxicity value for freshwater fish are used. Acute and chronic RQ values for freshwater fish that serve as surrogates for aquatic-phase CRLF are provided in **Table 30.**

Acute RQs for aquatic-phase CRLF are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. Acute RQs for uses that are applied via soil in-furrow treatment (*i.e*., cotton and garlic) and seed treatments do not exceed LOCs.

Chronic RQs for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Chronic RQs for uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments do not exceed LOCs.

Table 30. Summary of Direct Acute and Chronic Effect[1] RQs for the Aquatic-phase CRLF Based on an Acute Channel Catfish 96-hr LC_{50} of 3,100 µg/L and a Chronic Fathead Minnow NOAEC of 260 µg/L. EECs represent iprodione residues of concern.

Use(s)	Peak EEC (µg/L)	60-d EEC (µg/L)	Acute RQ	Chronic RQ
Almonds	170.8	169.7	**0.06**[2]	0.65
Beans	223.8	221.7	**0.07**[2]	0.85
Broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	14.6	14.4	<0.01	0.06
Berries[4]	321.0	317.1	**0.10**[2]	**1.22**[3]
Canola (foliar)	811.8	808.8	**0.26**[2]	**3.11**[3]
Canola (seed treatment)	43.0	40.7	0.01	0.16
Carrots (foliar)	449.5	446.4	**0.15**[2]	**1.72**[3]
Carrots (seed treatment)	16.5	16.2	0.01	0.06
Cole Crops[5] and crucifer	1179.0	1179.0	**0.38**[2]	**4.53**[3]
Conifers	323.9	322.3	**0.10**[2]	**1.24**[3]
Cotton	8.7	8.6	<0.01	0.03
Garlic	59.8	59.0	0.02	0.23
Grapes	318.4	315.3	**0.10**[2]	**1.21**[3]
Kohlrabi (seed treatment)	49.1	48.2	0.02	0.19
Lettuce (aerial)	660.1	654.8	**0.21**[2]	**2.52**[3]
Lettuce (ground)	728.1	726.6	**0.23**[2]	**2.79**[3]
Onions	269.3	267.3	**0.09**[2]	**1.03**[3]
Ornamentals (drench - 1 application)	1575.0	1538.0	**0.51**[2]	**5.92**[3]
Ornamentals (drench - 26 applications)	52050.0	51270.0	**16.79**[2]	**197**[3]
Ornamentals (foliar-1 application)	248.9	246.1	**0.08**[2]	0.95
Ornamentals (foliar-26 applications)	7683.0	7609.0	**2.48**[2]	**29.3**[3]
Peanuts	210.8	208.7	**0.07**[2]	0.80
Potatoes	281.0	277.1	**0.09**[2]	**1.07**[3]
Radishes (foliar)	358.2	355.1	**0.12**[2]	**1.37**[3]
Radishes (seed treatment)	16.0	16.0	0.01	0.06
Rutabagas (foliar)	348.0	344.0	**0.11**[2]	**1.32**[3]
Rutabagas (seed treatment)	2.2	2.2	<0.01	0.01
Stone Fruit[6]	219.5	217.5	**0.07**[2]	0.84
Strawberries	183.8	182.7	**0.06**[2]	0.70
Turf (golf course - greens, tees and aprons) (fall)	1379.0	1369.0	**0.44**[2]	**5.27**[3]
Turf (golf course - greens, tees and aprons) (spring)	829.1	821.3	**0.27**[2]	**3.16**[3]
Turf (golf course, sod farm, commercial industrial lawns) (fall)	1529.0	1519.0	**0.49**[2]	**5.84**[3]
Turf (golf course, sod farm, commercial industrial lawns) (spring)	903.1	898.2	**0.29**[2]	**3.45**[3]
Turnip greens (foliar)	1118.0	1108.0	**0.36**[2]	**4.26**[3]
Turnip greens (seed treatment)	23.3	23.1	0.01	0.09

[1] RQs associated with acute and chronic direct toxicity to the CRLF are also used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items.
[2] RQ exceeds acute risk to endangered species LOC of 0.05.
[3] RQ exceeds chronic risk to endangered species LOC of 1.0.
[4] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[5] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[6] Specifically: apricots, cherries, nectarines, peaches, plums, prunes

5.1.1.2 Indirect Effects to Aquatic-Phase CRLF via Reduction in Prey

Non-vascular Aquatic Plants

Indirect effects of iprodione to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on peak EECs for iprodione residues of concern relevant to the standard pond and the lowest toxicity value (EC_{50}) for aquatic non-vascular plants (*i.e.*, EC_{50} for *Navicula pelliculosa* = 50 µg/L). RQs for non-vascular plants are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow treatment to cotton and all seed treatments are below the LOC (**Table 31**).

Aquatic Invertebrates

Indirect acute effects to the aquatic-phase CRLF via effects to aquatic invertebrates (prey) in aquatic habitats are based on peak EECs for iprodione residues of concern in the standard pond and the lowest acute toxicity value for freshwater invertebrates, *i.e.*, *D. magna* 48-hr EC_{50}=240 µg/L. For chronic risks, 21-day EECs and the lowest chronic toxicity value for invertebrates (*D. magna* NOAEC=170 µg/L) are used to derive RQs.

Acute RQs for aquatic invertebrates exceed the LOC for all uses of iprodione, except cotton (in-furrow) and seed treatments to rutabagas and turnip greens. Chronic RQs except the LOC for all uses of iprodione, except cotton (in-furrow) and seed treatments of broccoli, Brussels sprouts, cabbage, cauliflower, kale, carrots, kohlrabi, radishes, rutabagas and turnip greens. All RQs for uses where iprodione is applied via ground spray, chemigation or aerial spray are sufficient to exceed acute and chronic LOCs (**Table 32**).

Fish and Frogs

Fish and frogs also represent potential prey items of adult aquatic-phase CRLFs. RQs associated with acute and chronic direct toxicity to the CRLF **(Table 30)** are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items. As noted above, acute RQs for aquatic-phase CRLF are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. Chronic RQs for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments do not exceed LOCs.

Table 31. Summary of RQs Used to Estimate Indirect Effects to the CRLF via Effects to Non-Vascular Aquatic Plants (diet of CRLF in tadpole life stage and habitat of aquatic-phase CRLF) Based on an EC_{50} of 50 µg/L for *Navicula pelliculosa*. EECs represent iprodione residues of concern.

Use(s)	Peak EEC (µg/L)	RQ
Almonds	170.8	**3.42**[1]
Beans	223.8	**4.48**[1]
broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	14.6	0.29
Berries[2]	321.0	**6.42**[1]
Canola (foliar)	811.8	**16.24**[1]
Canola (seed treatment)	43.0	0.86
Carrots (foliar)	449.5	**8.99**[1]
Carrots (seed treatment)	16.5	0.33
Cole Crops[3] and crucifer	1179.0	**23.6**[1]
Conifers	323.9	**6.48**[1]
Cotton	8.7	0.17
Garlic	59.8	**1.20**[1]
Grapes	318.4	**6.37**[1]
Kohlrabi (seed treatment)	49.1	0.98
Lettuce (aerial)	660.1	**13.2**[1]
Lettuce (ground)	728.1	**14.6**[1]
Onions	269.3	**5.39**[1]
Ornamentals (drench - 1 application)	1575.0	**31.5**[1]
Ornamentals (drench - 26 applications)	52050.0	**1041**[1]
Ornamentals (foliar-1 application)	248.9	**4.98**[1]
Ornamentals (foliar-26 applications)	7683.0	**153.7**[1]
Peanuts	210.8	**4.22**[1]
Potatoes	281.0	**5.62**[1]
Radishes (foliar)	358.2	**7.16**[1]
Radishes (seed treatment)	16.0	0.32
Rutabagas (foliar)	348.0	**6.96**[1]
Rutabagas (seed treatment)	2.2	0.04
Stone Fruit[4]	219.5	**4.39**[1]
Strawberries	183.8	**3.68**[1]
turf (golf course - greens, tees and aprons) (fall)	1379.0	**27.6**[1]
turf (golf course - greens, tees and aprons) (spring)	829.1	**16.6**[1]
turf (golf course, sod farm, commercial industrial lawns) (fall)	1529.0	**30.6**[1]
turf (golf course, sod farm, commercial industrial lawns) (spring)	903.1	**18.1**[1]
turnip greens (foliar)	1118.0	**22.4**[1]
turnip greens (seed treatment)	23.3	0.47

[1] Exceeds risk to aquatic plant LOC of 1.0
[2] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4] Specifically: apricots, cherries, nectarines, peaches, plums, prunes

Table 32. Summary of Acute and Chronic RQs Used to Estimate Indirect Effects to the CRLF via Direct Effects on Aquatic Invertebrates as Dietary Food Items (prey of CRLF juveniles and adults in aquatic habitats) Based on an Acute 48-hr EC_{50} and Chronic NOAEC for *Daphnia magna* of 240 µg/L And 170 µg/L, respectively. EECs represent iprodione residues of concern.

Use(s)	Peak EEC (µg/L)	21-d EEC (µg/L)	Acute RQ	Chronic RQ
Almonds	170.8	170.7	**0.71**[2]	**1.00**[3]
Beans	223.8	222.8	**0.93**[2]	**1.31**[3]
Broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	14.6	14.4	**0.06**[2]	0.08
Berries [4]	321.0	319.0	**1.34**[2]	**1.88**[3]
Canola (foliar)	811.8	810.7	**3.38**[2]	**4.77**[3]
Canola (seed treatment)	43.0	41.9	**0.18**[2]	0.25
Carrots (foliar)	449.5	448.4	**1.87**[2]	**2.64**[3]
Carrots (seed treatment)	16.5	16.2	**0.07**[2]	0.10
Cole Crops [5] and crucifer	1179.0	1179.0	**4.91**[2]	**6.94**[3]
Conifers	323.9	323.7	**1.35**[2]	**1.90**[3]
Cotton	8.7	8.6	0.04	0.05
Garlic	59.8	59.4	**0.25**[2]	0.35
Grapes	318.4	316.4	**1.33**[2]	**1.86**[3]
Kohlrabi (seed treatment)	49.1	48.4	**0.20**[2]	0.28
Lettuce (aerial)	660.1	658.0	**2.75**[2]	**3.87**[3]
Lettuce (ground)	728.1	727.9	**3.03**[2]	**4.28**[3]
Onions	269.3	269.2	**1.12**[2]	**1.58**[3]
Ornamentals (drench - 1 application)	1575.0	1538.0	**6.56**[2]	**9.05**[3]
Ornamentals (drench - 26 applications)	52050.0	51760.0	**217**[2]	**305**[3]
Ornamentals (foliar-1 application)	248.9	246.1	**1.04**[2]	**1.45**[3]
Ornamentals (foliar-26 applications)	7683.0	7654.0	**32.0**[2]	**45.0**[3]
Peanuts	210.8	209.8	**0.88**[2]	**1.23**[3]
Potatoes	281.0	279.1	**1.17**[2]	**1.64**[3]
Radishes (foliar)	358.2	357.1	**1.49**[2]	**2.10**[3]
Radishes (seed treatment)	16.0	16.0	**0.07**[2]	0.09
Rutabagas (foliar)	348.0	346.0	**1.45**[2]	**2.04**[3]
Rutabagas (seed treatment)	2.2	2.2	0.01	0.01
Stone Fruit [6]	219.5	218.5	**0.91**[2]	**1.29**[3]
Strawberries	183.8	182.8	**0.77**[2]	**1.08**[3]
Turf (golf course - greens, tees and aprons) (fall)	1379.0	1370.0	**5.75**[2]	**8.06**[3]
Turf (golf course - greens, tees and aprons) (spring)	829.1	826.1	**3.45**[2]	**4.86**[3]
Turf (golf course, sod farm, commercial industrial lawns) (fall)	1529.0	1520.0	**6.37**[2]	**8.94**[3]
Turf (golf course, sod farm, commercial industrial lawns) (spring)	903.1	901.2	**3.76**[2]	**5.30**[3]
Turnip greens (foliar)	1118.0	1108.0	**4.66**[2]	**6.52**[3]
Turnip greens (seed treatment)	23.3	23.2	0.10	0.14

[1]RQs associated with acute and chronic direct toxicity to the CRLF are also used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items.
[2]RQ > acute risk ton endangered species LOC of 0.05.
[3]RQ> chronic risk LOC of 1.0
[4]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[5]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[6]Specifically: apricots, cherries, nectarines, peaches, plums, prunes

5.1.1.3 Indirect Effects to CRLF via Reduction in Habitat and/or Primary Productivity (Freshwater Aquatic Plants)

Indirect effects to the CRLF via effects to aquatic plants are estimated using the most sensitive non-vascular and vascular plant toxicity endpoints. Because there are no obligate relationships between the CRLF and any aquatic plant species, the most sensitive EC_{50} values, rather than NOAEC values, were used to derive RQs.

As noted above, RQs for non-vascular plants are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow treatment to cotton and all seed treatments are below the LOC (**Table 33**).

For vascular plants, the EEC for the high-end use scenario for drench applications to ornamentals is above the absolute value of the (non-definitive) EC50 for *L. gibba*. All EECs, are well below the non-definitive EC50, resulting in no LOC exceedances for any use except drench applications to ornamentals (**Table 33**).

Table 33. Summary of RQs Used to Estimate Indirect Effects to the CRLF via Effects to aquatic habitat. Based on an EC50 of 50 µg/L for *Navicula pelliculosa* (algae) and an EC50 of EC_{50} >12,640 µg/L for *Lemna gibba* (vascular). EECs represent iprodione residues of concern.

Use(s)	Peak EEC (µg/L)	Algae RQ	Vascular Aquatic Plant RQ
Almonds	170.8	**3.42**[1]	<0.01
Beans	223.8	**4.48**[1]	<0.02
Broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	14.6	0.29	<0.01
Berries[2]	321.0	**6.42**[1]	<0.03
Canola (foliar)	811.8	**16.2**[1]	<0.06
Canola (seed treatment)	43.0	0.86	<0.01
Carrots (foliar)	449.5	**8.99**[1]	<0.04
Carrots (seed treatment)	16.5	0.33	<0.01
Cole Crops[3] and crucifer	1179.0	**23.6**[1]	<0.09
Conifers	323.9	**6.48**[1]	<0.03
Cotton	8.7	0.17	<0.01
Garlic	59.8	**1.20**[1]	<0.01
Grapes	318.4	**6.37**[1]	<0.03
Kohlrabi (seed treatment)	49.1	0.98	<0.01
Lettuce (aerial)	660.1	**13.2**[1]	<0.05
Lettuce (ground)	728.1	**14.6**[1]	<0.06
Onions	269.3	**5.39**[1]	<0.02
Ornamentals (drench - 1 application)	1575.0	**31.5**[1]	<0.12
Ornamentals (drench - 26 applications)	52050.0	**1041**[1]	<**4.12**[1]
Ornamentals (foliar-1 application)	248.9	**4.98**[1]	<0.02
Ornamentals (foliar-26 applications)	7683.0	**153.7**[1]	<0.61
Peanuts	210.8	**4.22**[1]	<0.02
Potatoes	281.0	**5.62**[1]	<0.02
Radishes (foliar)	358.2	**7.16**[1]	<0.03
Radishes (seed treatment)	16.0	0.32	<0.01
Rutabagas (foliar)	348.0	**6.96**[1]	<0.03
Rutabagas (seed treatment)	2.2	0.04	<0.01
Stone Fruit[4]	219.5	**4.39**[1]	<0.02
Strawberries	183.8	**3.68**[1]	<0.01
Turf (golf course - greens, tees and aprons) (fall)	1379.0	**27.6**[1]	<0.11
Turf (golf course - greens, tees and aprons) (spring)	829.1	**16.6**[1]	<0.07
Turf (golf course, sod farm, commercial industrial lawns) (fall)	1529.0	**30.6**[1]	<0.12
Turf (golf course, sod farm, commercial industrial lawns) (spring)	903.1	**18.1**[1]	<0.07
Turnip greens (foliar)	1118.0	**22.4**[1]	<0.09
Turnip greens (seed treatment)	23.3	0.47	<0.01

[1] Exceeds risk to aquatic plant LOC of 1.0
[2] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4] Specifically: apricots, cherries, nectarines, peaches, plums, prunes

5.1.2 Exposures in the Terrestrial Habitat

5.1.2.1 Direct Effects to Terrestrial-phase CRLF

As previously discussed in Section 3.3, potential direct effects to terrestrial-phase CRLFs are based on foliar applications of iprodione.

Potential direct acute effects to the terrestrial-phase CRLF are derived by considering dose- and dietary-based EECs modeled in T-REX for a small bird (20 g) consuming small invertebrates and acute oral and subacute dietary toxicity endpoints for avian species.

Potential direct chronic effects of iprodione to the terrestrial-phase CRLF are derived by considering dietary-based exposures modeled in T-REX for a small bird (20g) consuming small invertebrates. Chronic effects are estimated using the lowest available toxicity data for birds. EECs are divided by toxicity values to estimate chronic dietary-based RQs. Acute dose-based RQ values based on a Northern bobwhite quail acute oral LD_{50} of 930 mg/kg bw exceed the acute risk to listed species LOC (RQ>0.1) for all of the uses evaluated except cotton (**Table 34**). Iprodione is practically nontoxic to birds and to the terrestrial-phase amphibians for which they serve as surrogates on a sub-acute dietary exposure basis with a Northern bobwhite quail dietary LC_{50}>5,620 mg/kg diet; however, EECs are sufficiently high to result in LOC exceedances for iprodione uses on conifers, ornamental plants and turf. Chronic dietary-based RQ values exceed the chronic risk LOC (RQ>1) for all of the uses evaluated except for almonds, beans, cotton, garlic, onions, peanuts and strawberries. Based on exceedances of the acute risk to listed species LOC and the chronic risk LOC, iprodione may directly affect the terrestrial-phase of the CRLF.

Table 34. Summary of Acute Dose- and Dietary-based RQs and Chronic Dietary-based RQ Values Used to Estimate Direct Effects to the Terrestrial-phase CRLF (non-granular application).

Use	Dose-based Acute RQ[1]	Dietary-based Acute RQ[2]	Dietary-based Chronic RQ[3]
Almonds	**0.38[4]**	<0.04	0.69
Beans	**0.44[4]**	<0.05	0.79
Berries [6]	**0.64[4]**	<0.07	**1.15[5]**
Canola	**0.89[4]**	<0.09	**1.61[5]**
Carrots	**0.73[4]**	<0.08	**1.37[5]**
Cole Crops [7]	**0.89[4]**	<0.09	**1.61[5]**
Conifers	**0.94[4]**	**<0.10[4]**	**1.71[5]**
Cotton	0.06	<0.01	0.11
Crucifer	**0.89[4]**	<0.09	**1.61[5]**
Garlic	**0.46[4]**	<0.05	0.83
Grapes	**0.75[4]**	<0.08	**1.37[5]**
Lettuce (aerial)	**0.57[4]**	<0.06	**1.04[5]**
Lettuce (ground)	**0.70[4]**	<0.07	**1.27[5]**
Onion	**0.53[4]**	<0.06	0.97
Ornamentals (drench high)	**21.3[4]**	**<2.22[4]**	**38.6[5]**
Ornamentals (drench low)	**5.15[d]**	**<0.54[4]**	**9.35[5]**
Ornamentals (foliar high)	**3.56[4]**	**<0.37[4]**	**6.47[5]**
Ornamentals (foliar low)	**0.64[4]**	<0.07	**1.17[5]**
Peanuts	**0.54[4]**	<0.06	0.97
Potato	**0.70[4]**	<0.07	**1.27[5]**
Radish	**0.89[4]**	<0.08	**1.46[5]**
Rutabaga	**0.89[4]**	<0.09	**1.61[5]**
Stone Fruit[8]	**0.59[4]**	<0.06	**1.07[5]**
Strawberries	**0.23[4]**	<0.02	0.42
Turf (sod)	**5.29[4]**	**<0.34[4]**	**5.98[5]**
Turf (tees)	**3.45[4]**	**<0.36[4]**	**6.27[5]**
Turnip greens	**0.89[4]**	<0.09	**1.61[5]**

[1]Based on dose-based EEC and iprodione Northern bobwhite quail acute oral LD_{50} = 930 mg/kg-bw
[2]Based on dose-based EEC and iprodione Northern bobwhite quail subacute dietary LC_{50} >5,620 mg/kg-diet
[3]Based on dietary-based EEC and iprodione Northern bobwhite quail NOAEC = 324 mg/kg-diet.
[4] RQ > acute risk to endangered species LOC of 0.1.
[5]RQ> chronic risk LOC of 1.0
[6]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[7]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[8]Specifically: apricots, cherries, nectarines, peaches, plums, prunes

5.1.2.2 Indirect Effects to Terrestrial-Phase CRLF via Reduction in Prey

Terrestrial Invertebrates

In order to assess the risks of iprodione to terrestrial invertebrates, which are considered prey of CRLF in terrestrial habitats, the honey bee is used as a surrogate for terrestrial invertebrates. The toxicity value for terrestrial invertebrates is calculated by multiplying the lowest available acute contact LD_{50} of >120 µg a.i./bee by 1 bee/0.128g, which is based on the weight of an adult honey bee. EECs (µg a.i./g of bee) calculated by T-REX for small and large insects are divided by the calculated toxicity value for terrestrial invertebrates, which is >938 μg a.i./g of bee. Iprodione is classified as practically nontoxic to bees on an acute contact exposure basis since the 96-hr LD_{50} is greater than the highest dose tested, *i.e.*, 120 μg a.i./bee. As such, all of the RQ values are less than the calculated values that range from <0.04 to <13.3 for small insects and from <0.004 to <1.48 for large insects (**Table 35**). For all of the uses except treatments to turf (golf courses and sod) and ornamental plants, all of the maximum EECs are below the treatment level where no mortality was observed in the acute contact toxicity study. Although there was no mortality at the highest dose tested in the acute contact toxicity study with honeybees, there is uncertainty whether terrestrial invertebrates may be affected at the exposure concentrations estimated for iprodione uses on turf and ornamental plants. Because of this uncertainty, iprodione may affect the CRLF via reduction in terrestrial invertebrate prey items.

Table 35. Summary of RQ Used to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Terrestrial Invertebrates as Dietary Food Items.

Use (Application method)	Small Insect EEC (ppm)	Large Insect EEC (ppm)	Small Insect RQ[1] Value	Large Insect RQ[2] Value
Almonds	222	25	<0.24	<0.03
Beans	257	29	<0.27	<0.03
Berries[4]	374	42	<0.40	<0.04
Canola	521	58	<0.56	<0.06
Carrots	444	49	<0.47	<0.05
Cole crops[5]	521	58	<0.56	<0.06
Conifers	555	62	<0.59	<0.07
Cotton	37	4.1	<0.04	<0.004
Crucifer	521	58	<0.56	<0.06
Garlic	270	30	<0.29	<0.03
Grapes	444	49	<0.47	<0.05
Lettuce (aerial)	337	37	<0.36	<0.04
Lettuce (ground application)	411	46	<0.44	<0.05
Onions	314	35	<0.33	<0.04
Ornamentals (drench high)	12502	1389	**<13.3**[3]	**<1.48**[3]
Ornamentals (drench low)	3029	337	**<3.23**[3]	<0.36
Ornamentals (foliar high)	2095	233	**<2.23**[3]	<0.25
Ornamentals (foliar low)	379	42	<0.40	<0.04
Peanut	315	35	<0.34	<0.04
Potato	411	46	<0.44	<0.05
Radish	521	58	<0.56	<0.06
Rutabaga	521	58	<0.56	<0.06
Stone fruits[6]	347	39	<0.37	<0.04
Strawberry	135	15	<0.14	<0.02
Turf (golf course, sod farms, commercial industrial lawns)	2032	226	**<2.16**[3]	<0.24
Turf (golf course: greens, tees and aprons)	1936	215	**<2.06**[3]	<0.23
Turnip greens	521	58	<0.56	<0.06

[1]RQ calculated by dividing small insect EEC by 938 µg/g of bee
[2]RQ calculated by dividing large insect EEC by 938 µg/g of bee
[3]EEC exceeds the highest equivalent concentration where no mortality was observed in acute honeybee contact toxicity test.
[4]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[5]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[6]Specifically: apricots, cherries, nectarines, peaches, plums, prunes

Mammals

Risks associated with ingestion of small mammals by large terrestrial-phase CRLFs are derived for dietary-based and dose-based exposures modeled in T-REX for a small mammal (15g) consuming short grass. Acute and chronic effects are estimated using the most sensitive mammalian toxicity data. EECs are divided by the toxicity value to estimate acute and chronic dose-based RQs as well as chronic dietary-based RQs. Acute dose-based RQ values range from 0.01 to 2.16 (**Table 36**); uses of iprodione on conifers, ornamental plants and turf (sod and golf courses) exceed the acute risk to listed species LOC of 0.1. Chronic dose-based RQ values range from 1.53 to 521 across all of the uses evaluated while chronic dietary-based RQ values range from 0.22 to 74.1 (**Table 36**). With the exception of iprodione use on cotton where chronic dietary-based RQ values were below the chronic risk LOC of 1.0, all of the other uses exceed the chronic risk LOC. When chronic, dietary-based exposures are considered for iprodione to mammals consuming treated seeds, the RQ is 278, which exceeds the LOC (1.0). Based on exceedances of the acute risk to listed species LOC and the chronic risk LOC, iprodione may indirectly affect the CRLF via reduction in small mammal prey items.

Table 36. Summary of Acute and Chronic RQs* Used to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Small Mammals as Dietary Food Items (non-granular application).

Use	Acute Dose-based RQ[1]	Chronic Dose-based RQ[2]	Chronic Dietary-based RQ[3]
Almonds	0.04	**9.25**[5]	**1.32**[5]
Beans	0.04	**10.7**[5]	**1.52**[5]
Berries [6]	0.06	**15.6**[5]	**2.21**[5]
Canola	0.09	**21.7**[5]	**3.09**[5]
Carrots	0.08	**18.5**[5]	**2.63**[5]
Cole Crops [7]	0.09	**21.7**[5]	**3.09**[5]
Conifers	**0.10**[4]	**23.1**[5]	**3.29**[5]
Cotton	0.01	**1.53**[5]	0.22
Crucifer	0.09	**21.7**[5]	**3.09**[5]
Garlic	0.05	**11.3**[5]	**1.60**[5]
Grapes	0.08	**18.5**[5]	**2.63**[5]
Lettuce (aerial)	0.06	**14.3**[5]	**1.99**[5]
Lettuce (ground)	0.07	**17.1**[5]	**2.44**[5]
Onion	0.05	**13.1**[5]	**1.86**[5]
Ornamentals (drench high)	**2.16**[4]	**521**[5]	**74.1**[5]
Ornamentals (drench low)	**0.52**[4]	**126**[5]	**18.0**[5]
Ornamentals (foliar high)	**0.36**[4]	**87.4**[5]	**12.4**[5]
Ornamentals (foliar low)	0.07	**15.8**[5]	**2.24**[5]
Peanuts	0.05	**13.1**[5]	**1.87**[5]
Potato	0.07	**17.1**[5]	**2.44**[5]
Radish	0.08	**19.7**[5]	**2.80**[5]
Rutabaga	0.09	**21.7**[5]	**3.09**[5]
Stone Fruit [8]	0.06	**14.5**[5]	**2.05**[5]
Strawberries	0.02	**5.63**[5]	0.80
Turf (sod)	**0.33**[4]	**80.7**[5]	**11.5**[5]
Turf (tees)	**0.35**[4]	**84.7**[5]	**12.0**[5]
Turnip greens	0.09	**21.7**[5]	**3.09**[5]

[1]Based on dose-based EEC and iprodione rat acute oral LD_{50} = 4,468 mg/kg-bw
[2]Based on dose-based EEC and iprodione rat NOAEL = 18.5 mg/kg-bw.
[3]Based on dietary-based EEC and iprodione rat NOAEC = 300 mg/kg-diet.
[4] RQ > acute risk to endangered species LOC of 0.1.
[5] RQ> chronic risk LOC of 1.0
[6]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[7]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[8]Specifically: apricots, cherries, nectarines, peaches, plums, prunes

Frogs

An additional prey item of the adult terrestrial-phase CRLF is other species of frogs. In order to assess risks to these organisms, dietary-based and dose-based exposures modeled in T-REX for a small bird (20g) consuming small invertebrates are used. Based on exceedances of the acute risk to listed species and chronic risk LOCs, iprodione may directly affect terrestrial-phase amphibians that may serve as prey for CRLF; see Section 5.1.2.1 and associated table (**Table 34**) for results. As such, iprodione may indirectly affect the CRLF via reduction in frogs as prey items.

5.1.2.3 Indirect Effects to CRLF via Reduction in Terrestrial Plant Community (Riparian and Upland Habitat)

Potential indirect effects to the CRLF resulting from direct effects on riparian and upland vegetation are assessed using RQs from terrestrial plant seedling emergence and vegetative vigor EC_{25} data as a screen. Since no acceptable data are available with which to quantitatively assess the potential effects of iprodione on terrestrial plants and given the weight-of-evidence available through open literature showing effects of iprodione to terrestrial plants, risk is presumed. As such iprodione may indirectly affect the CRLF via reduction in terrestrial plants.

5.1.3 Primary Constituent Elements of Designated Critical Habitat

For iprodione use, the assessment endpoints for designated critical habitat PCEs involve a reduction and/or modification of food sources necessary for normal growth and viability of aquatic-phase CRLFs, and/or a reduction and/or modification of food sources for terrestrial-phase juveniles and adults. Because these endpoints are also being assessed relative to the potential for indirect effects to aquatic- and terrestrial-phase CRLF, the effects determinations for indirect effects from the potential loss of food items are used as the basis of the effects determination for potential modification to designated critical habitat.

5.1.3.1 Aquatic-Phase (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.

- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

Based on the risk estimation for potential effects to aquatic and/or terrestrial plants provided above (see **Table 33**), iprodione use has the potential to cause effects to aquatic plants. No acceptable data are available with which to quantitatively assess the potential effects of iprodione on terrestrial plants, which serve as surrogates for riparian vegetation; however, the weight-of-evidence provide through open literature studies suggests that iprodione exposure at label rates can result in adverse effects on terrestrial plants. Therefore, risk to riparian vegetation is presumed. Therefore, iprodione may affect aquatic-phase PCEs of designated habitat related to vegetation.

The remaining aquatic-phase PCE is "alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source." To assess the impact of iprodione on this PCE (*i.e.*, alteration of food sources), acute and chronic freshwater fish and invertebrate toxicity endpoints, as well endpoints for aquatic non-vascular plants, are used as measures of effects. RQs for these endpoints are provided in section 5.1.1. Based on LOC exceedances for the majority of iprodione uses for aquatic-phase CRLF, aquatic invertebrates, algae or fish, iprodione may affect aquatic-phase PCEs of designated habitat related to effects of alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.

5.1.3.2 Terrestrial-Phase (Upland Habitat and Dispersal Habitat)

The first two assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance
- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal

The risk estimation for terrestrial-phase PCEs of designated habitat related to potential effects on terrestrial plants is provided above. Since no acceptable data are available with which to quantitatively assess the potential effects of iprodione on terrestrial plants but given the weight-of-evidence provided through open literature studies, risk is presumed. As such, iprodione may result in modification of the terrestrial habitat of the CRLF.

The third terrestrial-phase PCE is "reduction and/or modification of food sources for terrestrial phase juveniles and adults." To assess the impact of iprodione on this PCE, acute and chronic toxicity endpoints for birds, mammals, and terrestrial invertebrates are used as measures of effects. RQs for these endpoints are provided above. Because RQs exceed LOCs for all uses of iprodione for at least one prey item of the terrestrial-phase CRLF, all uses of iprodione may result in modification of the terrestrial habitat of the CRLF.

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. Direct acute and chronic RQs for terrestrial-phase CRLFs are presented above. Because RQs exceed LOCs for all uses of iprodione for the CRLF or at least one prey item of the terrestrial-phase CRLF, all uses of iprodione may result in modification of the terrestrial habitat of the CRLF.

5.2 Risk Description

The risk description synthesizes an overall conclusion regarding the likelihood of adverse impacts leading to an effects determination (*i.e*., "no effect," "may affect, but not likely to adversely affect," or "likely to adversely affect") for the CRLF and its designated critical habitat.

Based on the RQs presented in the Risk Estimation (Section 5.1) a preliminary effects determination for all uses of iprodione is "may affect" for the CRLF and critical habitat. The direct or indirect effect LOCs are exceeded and these effects may modify the PCEs of the CRLF's critical habitat, the Agency concludes a preliminary "may affect" determination for the FIFRA regulatory action regarding iprodione. A summary of the results of the risk estimation results are provided in **Table 37** for direct and indirect effects to the CRLF and in **Table 38** for the PCEs of designated critical habitat for the CRLF.

Table 37. Risk Estimation Summary for Iprodione- Direct and Indirect Effects to CRLF.

Assessment Endpoint	LOC Exceedances (Y/N)	Description of Results of Risk Estimation
Aquatic-phase CRLF *(eggs, larvae, tadpoles, juveniles, and adults)*		
Direct Effects Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	Yes	Acute and chronic RQ values (based on iprodione residues of concern) exceed the LOCs for the majority of iprodione uses.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants)	Yes	RQs for non-vascular plants and acute and chronic RQs for aquatic invertebrates exceed the LOCs for the majority of iprodione uses.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	Yes	The risk to aquatic nonvascular plant LOC is exceeded for the majority of iprodione uses.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	Yes	There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed.
Terrestrial-phase CRLF *(Juveniles and adults)*		
Direct Effects Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	Yes	Acute dose-based and dietary-based RQ values exceed the acute risk to listed species LOC; dose-based RQ values exceed the acute risk to listed species LOC by factors as high as 213X. Dietary-based chronic RQ values exceed the chronic risk LOC by factors as high as 39X.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.*, terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	Yes	Acute risk to terrestrial invertebrates could potentially exceed the level of concern for uses of iprodione on ornamental plants and turf. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Acute and chronic RQ values exceed the acute and chronic risk LOCs for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on habitat (*i.e.*, riparian vegetation)	Yes	There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants

Table 38. Risk Estimation Summary for Iprodione– PCEs of Designated Critical Habitat for the CRLF.

Assessment Endpoint	LOC Exceedances (Y/N)	Description of Results of Risk Estimation
Aquatic-phase CRLF PCEs ***(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)***		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	Yes	There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Yes	There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	Yes	RQs for non-vascular plants and acute and chronic RQs for CRLF, aquatic invertebrates and fish exceed the LOCs for the majority of iprodione uses.
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	Yes	RQs for aquatic non-vascular plants exceed the LOC for the majority of iprodione uses.
Terrestrial-phase CRLF PCEs ***(Upland Habitat and Dispersal Habitat)***		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	Yes	There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	Yes	There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed.
Reduction and/or modification of food sources for terrestrial-phase juveniles and adults	Yes	Acute risk to terrestrial invertebrates could potentially exceed the level of concern for uses of iprodione on ornamental plants and turf. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Acute and chronic RQ values exceed the acute and chronic risk LOCs for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF.
Alteration of chemical characteristics necessary for	Yes	Acute risk to terrestrial invertebrates could

Assessment Endpoint	LOC Exceedances (Y/N)	Description of Results of Risk Estimation
normal growth and viability of juvenile and adult CRLFs and their food source.		potentially exceed the level of concern for uses of iprodione on ornamental plants and turf. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Acute and chronic RQ values exceed the acute and chronic risk LOCs for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF.

Following a "may affect" determination, additional information is considered to refine the potential for exposure at the predicted levels based on the life history characteristics (*i.e.*, habitat range, feeding preferences, etc.) of the CRLF. Based on the best available information, the Agency uses the refined evaluation to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that are "likely to adversely affect" the CRLF and its designated critical habitat.

The criteria used to make determinations that the effects of an action are "not likely to adversely affect" the CRLF and its designated critical habitat include the following:

- <u>Significance of Effect</u>: Insignificant effects are those that cannot be meaningfully measured, detected, or evaluated in the context of a level of effect where "take" occurs for even a single individual. "Take" in this context means to harass or harm, defined as the following:
    - Harm includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.
    - Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.
- <u>Likelihood of the Effect Occurring</u>: Discountable effects are those that are extremely unlikely to occur.
- <u>Adverse Nature of Effect</u>: Effects that are wholly beneficial without any adverse effects are not considered adverse.

A description of the risk and effects determination for each of the established assessment endpoints for the CRLF and its designated critical habitat is provided in Sections 5.2.1 through 5.2.3.

5.2.1 Direct Effects

5.2.1.1 Aquatic-Phase CRLF

The aquatic-phase considers life stages of the frog that are obligatory aquatic organisms, including eggs and larvae. It also considers submerged terrestrial-phase juveniles and adults, which spend a portion of their time in water bodies that may receive runoff and spray drift containing iprodione.

As described in Section 5.1.1.1 and **Table 30,** acute RQs for aquatic-phase CRLF are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. Chronic RQs for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (*i.e.*, cotton and garlic) and seed treatments do not exceed LOCs.

For use patterns that allow both aerial and ground spray applications according to the label, aerial applications were modeled since they have higher spray drift fractions and therefore higher EECs. For both ground and aerial applications the label requires a 25-ft buffer between application sites and waterbodies. The AgDRIFT model was used to predict the spray drift 25 ft from the application site following aerial and ground applications. AgDRIFT predicts 9.3% and 2.3% spray drift for aerial and ground spray applications, respectively. In order to gauge the impact that the lower spray drift value resulting from a ground spray application has on the EECs, the almond scenario was modeled both ways. Limiting the applications to ground spray would reduce the peak EEC from 171 to 78 µg/L, a reduction of greater than 50%. This suggests that mitigating the labels to only allow ground applications could result in reducing EECs for some uses to fall below LOCs for direct effects to the CRLF.

Available toxicity data for iprodione indicate that channel catfish are the most sensitive species tested, with a 96-hr LC_{50} of 3100 µg/L; however, toxicity testing with bluegill sunfish (*Lepomis macrochirus*) and rainbow trout (*Oncorhynchus mykiss*) resulted in 96-hr LC_{50} values of 3,700 (Sousa 1990*a*) and 4,100 µg/L (Sousa 1990*b*), respectively, indicating that acute toxicity estimates for technical grade iprodione are relatively consistent across the species tested. Although the dose response curve for channel catfish did not provide a probit slope estimate, probit dose response slopes are available for bluegill (slope = 11.8) and rainbow trout (slope = 8.2); the mean of the two slope estimates is 10 (standard error: ±1.8). This average slope is used (in IEC v1.1) to estimate the likelihood of individual mortality from acute exposures of aquatic-phase CRLF to iprodione residues of concern (**Table 39**). For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21×10^{35}). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1.

Table 39. Individual effects (mortality) chance analysis for acute exposures of aquatic-phase CRLF to iprodione residues of concern.

Use(s)	Acute RQ	Chance of individual mortality (~1 in…)
Almonds	**0.06**[1]	8.21E+35
Beans	**0.07**[1]	5.7E+29
Broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	<0.01	1.8E+119
Berries[2]	**0.10**[1]	2.9E+22
Canola (foliar)	**0.26**[1]	3.4E+08
Canola (seed treatment)	0.01	4.3E+76
Carrot (foliar)	**0.15**[1]	4.0E+16
Carrot (seed treatment)	0.01	1.3E+114
Cole Crops[3] and crucifer	**0.38**[1]	7.4E+04
Conifers	**0.10**[1]	2.0E+22
Cotton	<0.01	3.0E+143
Garlic	0.02	3.2E+65
Grapes	**0.10**[1]	4.1E+22
Kohlrabi (seed treatment)	0.02	1.1E+72
Lettuce (aerial)	**0.21**[1]	1.1E+11
Lettuce (ground)	**0.23**[1]	6.4E+09
Onions	**0.09**[1]	7.6E+25
Ornamentals (drench - 1 application)	**0.51**[1]	6.1E+02
Ornamentals (drench - 26 applications)	**16.8**[1]	1.0E+00
Ornamentals (foliar-1 application)	**0.08**[1]	3.1E+27
Ornamentals (foliar-26 applications)	**2.48**[1]	1.0E+00
Peanuts	**0.07**[1]	1.2E+31
Potatoes	**0.09**[1]	1.1E+25
Radishes (foliar)	**0.12**[1]	2.8E+20
Radishes (seed treatment)	0.01	1.8E+115
Rutabagas (foliar)	**0.11**[1]	9.3E+20
Rutabagas (seed treatment)	<0.01	1.1E+218
Stone Fruit[4]	**0.07**[1]	1.5E+30
Strawberries	**0.06**[1]	1.5E+34
Turf (golf course - greens, tees and aprons) (fall)	**0.44**[1]	4.6E+03
Turf (golf course - greens, tees and aprons) (spring)	**0.27**[1]	2.0E+08
Turf (golf course, sod farm, commercial industrial lawns) (fall)	**0.49**[1]	9.3E+02
Turf (golf course, sod farm, commercial industrial lawns) (spring)	**0.29**[1]	2.4E+07
Turnip greens (foliar)	**0.36**[1]	2.1E+05
Turnip greens (seed treatment)	0.01	4.2E+99

[1] Exceeds acute risk LOC of 0.05.
[2] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4] Specifically: apricots, cherries, nectarines, peaches, plums, prunes

There is considerable uncertainty in this assessment in the approach of modeling total residues of concern. In this assessment, it is assumed that iprodione, 3,5-DCA (iprodione's terminal degradate) and all major iprodione degradates containing the 3,5-DCA moiety are of concern. As noted previously, a limited amount of data are available to characterize the toxicity of 3,5-DCA to non-target organisms. No data are available to characterize the toxicities of iprodione's major degradates that contain the 3,5-DCA moiety. Therefore, it is assumed in this assessment that all of iprodione's residues of concern are equivalent in toxicity to iprodione. In order to explore effects of this uncertainty on risk conclusions, EECs were derived using PRZM/EXAMS for iprodione (only) based on ground spray, chemigation and aerial spray applications only. All input parameters were the same as those described in section 3.1, with the exception of the chemical-specific parameters that are defined in **Table 40**. EECs are provided in **Table 41**. If RQs were developed using EECs for high use on ornamentals (26 applications per year), they would be sufficient to exceed acute and chronic risk LOCs for the aquatic-phase CRLF.

Table 40. PRZM/EXAMS input parameters relevant to the fate of iprodione (only).

Input Parameter	Value	Comments
Molecular Wt. (g/mol)	330.2	See **Table 5**
Henry's Law Constant (atm-m^3/mol)	9.0×10^{-9}	See **Table 5**
Vapor pressure (torr)	2.7×10^{-7}	See **Table 5**
Solubility in water (mg/L @ pH 7, 20^{o}C)	13	See **Table 5**
Hydrolysis half-life (days)	4.7	Based on value for neutral water (pH 7) (See **Table 6**)
Aqueous photolysis (days)	67	See **Table 6**
Aerobic Soil Metabolism Half-life (days)	300	For iprodione, half life was estimated (deviating from Input Parameter Guidance, as guidance does not cover this situation) from 2 studies—one in which the half-life was >100 and one in which the half life was 300 days (See **Table 6**)
Aerobic Aquatic Metabolism Half-life (days)	0	Studies provided were dominated by hydrolysis, so assumed stable to aerobic metabolism
Anaerobic Aquatic Metabolism Half-life (days)	0	Studies provided were dominated by hydrolysis, so assumed stable
Koc	426	Mean of Koc values for iprodione (**Table 8**).

Inputs determined in accordance with EFED "Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides" dated February 28, 2002

Table 41. Aquatic EECs generated using PRZM/EXAMS for iprodione (only).

Use(s)	Peak EEC (μg/L)	21-d EEC (μg/L)	60-d EEC (μg/L)
Almonds	6.2	3.2	1.8
Beans	12.3	5.4	2.6
Berries[1]	7.5	3.6	2.6
Canola	39.6	16.2	8.2
Carrots	16.9	8.8	4.2
Cole Crops[2] and Crucifer	48.4	20.1	10.5
conifers	25.3	9.3	4.9
Grapes	9.3	5.1	2.9
Grapes	14.5	7.1	3.5
Lettuce (air ap)	32.8	12.8	6.0
Lettuce (ground ap)	33.1	12.3	5.5
Onion	5.1	2.7	2.1
Ornamentals (drench - 1 application)	142.8	50.8	20.3
Ornamentals (drench - 26 applications)	3560	1118	474.6
Ornamentals (foliar-1 application)	17.7	6.3	2.6
Ornamentals (foliar-26 applications)	416.9	133.9	52.4
Peanut	10.3	3.3	1.9
Potato	8.0	4.0	2.6
Radish	9.6	5.4	3.4
Rutabaga	9.0	5.3	3.1
Stone furits (apricot, cherry, nectarine, peach, plum, prune)	11.1	5.3	2.6
Strawberry	14.7	6.1	2.7
turf (golf course - greens, tees and aprons) (fall)	72.9	26.4	10.5
turf (golf course - greens, tees and aprons) (spring)	21.9	10.2	5.5
turf (golf course, sod farm, commercial industrial lawns) (fall)	85.4	30.4	12.1
turf (golf course, sod farm, commercial industrial lawns) (spring)	18.0	8.8	5.0
turnip greens	44.9	18.3	8.6

USGS NAWQA monitoring data collected in California indicate detections as high as 141 μg/L, which are on the same order of magnitude as the highest EECs generated for iprodione (*i.e.*, those for use on ornamentals). This measured value exceeds peak iprodione (only) EECs generated for the majority of iprodione uses. If an acute RQ were developed using the highest detection of iprodione in surface water, this value would be 0.046.

In order to bound EECs relevant to 3,5-DCA, uses with the minimum and maximum peak EECs derived for iprodione residues of concern (i.e., cotton and 26 drench applications to ornamentals, respectively) were modeled. Use specific parameters include application methods and rates. Application methods, maximum rates per application and maximum number of applications per year are based on current label directions for use of iprodione on cotton and drench applications to ornamentals (**Table 20**). The application rate is converted to a 3,5-DCA equivalent using the molecular weight of 3,5-DCA. In this approach, available laboratory fate studies indicate that 3,5-DCA is the terminal degradate and that this degradate is stable; as such, it is assumed that 100% of iprodione is converted to 3,5-DCA at the time of application. Therefore, the maximum single application rate for cotton is equivalent to 0.147 kg of 3,5-DCA/ha (0.131 lbs a.i./A). The maximum single application rate for drench applications to ornamentals is 12.3 kg of 3,5-DCA/ha (11.0 lbs a.i./A).The input parameters relevant to the fate of 3,5-DCA used in PRZM and EXAMS are in Table 42. Aquatic EECs derived for 3,5-DCA based on uses of iprodione on cotton and ornamentals (26 drench applications) are provided in **Table 43**.

Table 42. PRZM/EXAMS input parameters relevant to the fate of 3,5-DCA.

Input Parameter	Value	Comments
Molecular Wt. (g/mol)	162.02	See **Table 5**
Henry's Law Constant (atm-m^3/mol)	5.8×10^{-6}	See **Table 5**
Vapor pressure (torr)	2.12×10^{-2}	See **Table 5**
Solubility in water (mg/L @ pH 7, 20^{o}C)	784	See **Table 5**
Hydrolysis half-life (days)	0	Assume stable
Aqueous photolysis (days)	0	Assume stable
Aerobic Soil Metabolism Half-life (days)	0	Assume stable
Aerobic Aquatic Metabolism Half-life (days)	0	Assume stable
Anaerobic Aquatic Metabolism Half-life (days)	0	Assume stable
Koc (L/kg_{OC})	610	Mean of Koc values for 3,5-DCA (**Table 9**).

Table 43. Aquatic EECs (µg/L) for 3,5-DCA based on iprodione Uses in California.

Crops Represented	Peak EECs	21-day average EECs	60-day average EECs
Cotton	2.15	1.60	1.06
Ornamentals (drench – 26 applications)	2216	1825	1364

As discussed previously, the toxicity of 3,5-DCA to fish (surrogates for aquatic-phase amphibians) is less than that of the parent compound. If RQ values were derived using aquatic EECs generated for 3,5-DCA in combination with available fish toxicity data for 3,5-DCA (guppy LC_{50}=3900 µg/L; zebrafish NOAEC = 1000 µg/L), acute and chronic RQs would be below their respective LOCs (0.05 and 1.0) for iprodione use on cotton and above the LOCs for the maximum iprodione use scenario of 26 drench applications to ornamentals.

Monitoring efforts in California have detected 3,5-DCA; however, it is uncertain whether these detections are associated with the use of iprodione. The maximum level of 3,5-DCA detected in surface water is 0.027 µg/L, a value that is several orders of magnitude lower than EECs provided in **Table 43**.

As discussed previously, iprodione use on golf courses has been associated with an ecological incident resulting in the death of an unspecified number of freshwater fish following a runoff event. This incident suggests that the application of iprodione to golf courses can result in aquatic exposures sufficient to cause mortality of aquatic vertebrates such as fish and amphibians. It should be noted that this incident occurred in 1992 and before the RED (USEPA 1998) indicating that the uses may have been associated with labels that were modified as a result of the RED.

Based on this information, there is potential for direct effects to the aquatic-phase CRLF from all iprodione uses that are applied via ground spray, chemigation or aerial spray. Effects are not expected from uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments.

5.2.1.2 Terrestrial-Phase CRLF

Acute exposures

As discussed in Section 5.1.2.1, acute dose-based RQ values generated using T-REX for small birds feeding on small insects exceed the acute risk to listed species LOC by factors ranging from 2.3x to 143x across all of the uses evaluated except for use on cotton.

In order to explore influences of amphibian-specific food intake equations on potential acute dose-based and chronic dietary-based exposures of the terrestrial-phase CRLF to iprodione, T-HERPS was used. An example output from T-HERPS is provided in Appendix L.

Refined acute, dietary-based RQs were not calculated because iprodione was classified as practically non-toxic to birds on a subacute dietary basis. EECs generated using T-REX for the terrestrial-phase CRLF are below the highest test level of the subacute studies with birds (*i.e.*, 5,620 mg/kg), with the exception of the high (*i.e.*, 26) application scenario for drench applications to ornamentals. This indicates that all uses of iprodione, with the exception of 4 drench applications to ornamentals, are not expected to pose a risk to terrestrial-phase CRLF through acute, dietary-based exposures.

Refined dose-based RQs for small sized (1.4 g) CRLF consuming insects do not exceed the acute listed species LOC (0.1) for all uses of iprodione, with the exception of the drench use on ornamentals (**Table 44**). In this case, only RQs representing the small CRLF consuming only small insects are sufficient to exceed the LOC, while the RQ for small CRLFs consuming large insects does not exceed the acute LOC. The acute, dose-based RQ for the small, terrestrial-phase CRLF exposed to iprodione from drench applications to ornamentals is between 0.01 and 0.52. This translates to a chance of individual effects ranging 1 in 10 to 1 in $8.9x10^{18}$ (derived using IECv1.1 and assuming a default slope of 4.5).

Refined dose-based RQs for medium sized (37 g) CRLF exceed the acute listed species LOC (0.1) for at least one food item for all uses of iprodione, with the exception use on cotton (**Table 45**). Acute, dose-based RQs are highest for medium CRLF consuming small herbivore mammals, with a range of 0.16 to 14.9 for all uses, excluding cotton. This translates to a chance of individual effects ranging 1 in 1to 1 in 5853 (derived using IECv1.1 and assuming a default slope of 4.5). For medium CRLF consuming small insectivore mammals, RQs for ornamentals and for turf exceed the LOC, with values ranging 0.14 to 0.93. This translates to a chance of individual effects ranging 1 in 2 to 1 in 16,400. For medium CRLF consuming small insects, RQs for ornamentals exceed the LOC, with values ranging 0.12 to 0.51. This translates to a chance of individual effects ranging 1 in 11 to 1 in 58,500. Acute, dose-based RQs for the medium terrestrial-phase CRLF consuming large insects and small, terrestrial-phase amphibians do not exceed the LOC.

Refined dose-based RQs for large-sized (238 g) CRLF exceed the acute listed species LOC (0.1) for at least one food item for iprodione use on canola, cole crops, conifers, crucifer, ornamentals, rutabagas, turf and turnip greens (**Table 46**). Acute, dose-based RQs are highest for medium CRLF consuming small herbivore mammals, with a range of 0.10 to 2.32 for uses where the LOC is exceeded. This translates to a chance of individual effects ranging 1 in 1 to 1 in 294,000 (derived using IECv1.1 and assuming a default slope of 4.5). For medium CRLF consuming small insectivore mammals and small insects, the only use where RQs exceed the LOC is drench applications to ornamentals, with RQs of 0.14 and 0.34, respectively. This translates to a chance of individual effects ranging 1 in 57 to 1 in 16,400. Acute, dose-based RQs for the large terrestrial-phase CRLF consuming large insects and small, terrestrial-phase amphibians do not exceed the LOC.

The most sensitive endpoint is an acute oral toxicity study with Northern bobwhite quail where the LD_{50} is 930 mg/kg bw (McGinnis 1973); however, in a more recent registrant-submitted study with Northern bobwhite quail, the acute oral LD_{50} value exceeded the highest concentration tested, *i.e.*, 2000 mg/kg bw, and where no mortality was observed in any of the treatment groups (Culotta *et al.* 1990). The more recent acute oral toxicity study by Culotta *et al*. (1990) is more consistent with the available subacute dietary toxicity studies indicating that iprodione is practically nontoxic to birds on a subacute dietary exposure basis. The subacute dietary toxicity studies for Northern bobwhite quail (Driscoll *et al.* 1990*a*) and for mallard ducks (*Anas platyrhyncos*; Driscoll *et al*. 1990*b*) both resulted in LC_{50} values greater than the highest concentration tested, *i.e.*, 5,620 mg/kg diet. In the quail study, 2 birds were dead in the 5,620 mg/kg diet group while in the mallard study none of the birds died.

Table 44. Revised dose-based RQs[1] for 1.4 g CRLF consuming different food items. EECs calculated using T-HERPS.

Use	Small insects	Large insects
Almonds	0.01	<0.01
Beans	0.01	<0.01
Berries[2]	0.02	<0.01
Canola	0.02	<0.01
Carrots	0.02	<0.01
Cole Crops [3]	0.02	<0.01
Conifers	0.02	<0.01
Cotton	<0.01	<0.01
Crucifer	0.02	<0.01
Garlic	0.01	<0.01
Grapes	0.02	<0.01
Lettuce (aerial)	0.01	<0.01
Lettuce (ground)	0.02	<0.01
Onions	0.01	<0.01
Ornamentals (drench high)	**0.52**[5]	0.06
Ornamentals (drench low)	**0.13**[5]	0.01
Ornamentals (foliar high)	0.09	0.01
Ornamentals (foliar low)	0.02	<0.01
Peanuts	0.01	<0.01
Potatoes	0.02	<0.01
Radishes	0.02	<0.01
Rutabagas	0.02	<0.01
Stone Fruit[4]	0.01	<0.01
Strawberries	0.01	<0.01
Turf (sod)	0.08	0.01
Turf (tees)	0.08	0.01
Turnip greens	0.02	<0.01

[1]Based on dose-based EEC and iprodione Northern bobwhite quail acute oral LD_{50} = 930 mg/kg-bw
[2]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[5] RQ > acute risk to endangered species LOC of 0.1.

Table 45. Revised dose-based RQs[1] for 37 g CRLF consuming different food items. EECs calculated using T-HERPS.

Use	Small insects	Large insects	Small herbivore mammals	Small insectivore mammals	Small terrestrial-phase amphibians
Almonds	0.01	<0.01	**0.26**[5]	0.02	<0.01
Beans	0.01	<0.01	**0.31**[5]	0.02	<0.01
Berries[2]	0.02	<0.01	**0.45**[5]	0.03	<0.01
Canola	0.02	<0.01	**0.62**[5]	0.04	<0.01
Carrots	0.02	<0.01	**0.53**[5]	0.03	<0.01
Cole Crops [3]	0.02	<0.01	**0.62**[5]	0.04	<0.01
Conifers	0.02	<0.01	**0.66**[5]	0.04	<0.01
Cotton	<0.01	<0.01	0.04	<0.01	<0.01
Crucifer	0.02	<0.01	**0.62**[5]	0.04	<0.01
Garlic	0.01	<0.01	**0.32**[5]	0.02	<0.01
Grapes	0.02	<0.01	**0.53**[5]	0.03	<0.01
Lettuce (aerial)	0.01	<0.01	**0.40**[5]	0.03	<0.01
Lettuce (ground)	0.02	<0.01	**0.49**[5]	0.03	<0.01
Onions	0.01	<0.01	**0.37**[5]	0.02	<0.01
Ornamentals (drench high)	**0.51**[5]	0.06	**14.9**[5]	**0.93**[5]	0.02
Ornamentals (drench low)	**0.12**[5]	0.01	**3.61**[5]	**0.23**[5]	<0.01
Ornamentals (foliar high)	0.09	0.01	**2.50**[5]	**0.16**[5]	<0.01
Ornamentals (foliar low)	0.02	<0.01	**0.45**[5]	0.03	<0.01
Peanuts	0.01	<0.01	**0.38**[5]	0.02	<0.01
Potatoes	0.02	<0.01	**0.49**[5]	0.03	<0.01
Radishes	0.02	<0.01	**0.56**[5]	0.04	<0.01
Rutabagas	0.02	<0.01	**0.62**[5]	0.04	<0.01
Stone Fruit[4]	0.01	<0.01	**0.41**[5]	0.03	<0.01
Strawberries	0.01	<0.01	**0.16**[5]	0.01	<0.01
Turf (sod)	0.08	0.01	**2.42**[5]	**0.15**[5]	<0.01
Turf (tees)	0.08	0.01	**2.31**[5]	**0.14**[5]	<0.01
Turnip greens	0.02	<0.01	**0.62**[5]	0.04	<0.01

[1]Based on dose-based EEC and iprodione Northern bobwhite quail acute oral LD_{50} = 930 mg/kg-bw
[2]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[5] RQ > acute risk to endangered species LOC of 0.1.

Table 46. Revised dose-based RQs[1] for 238 g CRLF consuming different food items. EECs calculated using T-HERPS.

Use	Small insects	Large insects	Small herbivore mammals	Small insectivore mammals	Small terrestrial-phase amphibians
Almonds	0.01	<0.01	0.04	<0.01	<0.01
Beans	0.01	<0.01	0.05	<0.01	<0.01
Berries[2]	0.01	<0.01	0.07	<0.01	<0.01
Canola	0.01	<0.01	**0.10**[5]	0.01	<0.01
Carrots	0.01	<0.01	0.08	0.01	<0.01
Cole Crops [3]	0.01	<0.01	**0.10**[5]	0.01	<0.01
Conifers	0.01	<0.01	**0.10**[5]	0.01	<0.01
Cotton	<0.01	<0.01	0.01	<0.01	<0.01
Crucifer	0.01	<0.01	**0.10**[5]	0.01	<0.01
Garlic	0.01	<0.01	0.05	<0.01	<0.01
Grapes	0.01	<0.01	0.08	0.01	<0.01
Lettuce (aerial)	0.01	<0.01	0.06	<0.01	<0.01
Lettuce (ground)	0.01	<0.01	0.08	<0.01	<0.01
Onions	0.01	<0.01	0.06	<0.01	<0.01
Ornamentals (drench high)	**0.34**[5]	0.04	**2.32**[5]	**0.14**[5]	0.01
Ornamentals (drench low)	0.08	0.01	**0.56**[5]	0.04	<0.01
Ornamentals (foliar high)	0.06	0.01	**0.39**[5]	0.02	<0.01
Ornamentals (foliar low)	0.01	<0.01	0.07	<0.01	<0.01
Peanuts	0.01	<0.01	0.06	<0.01	<0.01
Potatoes	0.01	<0.01	0.08	<0.01	<0.01
Radishes	0.01	<0.01	0.09	0.01	<0.01
Rutabagas	0.01	<0.01	**0.10**[5]	0.01	<0.01
Stone Fruit[4]	0.01	<0.01	0.06	<0.01	<0.01
Strawberries	<0.01	<0.01	0.03	<0.01	<0.01
Turf (sod)	0.05	0.01	**0.38**[5]	0.02	<0.01
Turf (tees)	0.05	0.01	**0.36**[5]	0.02	<0.01
Turnip greens	0.01	<0.01	**0.10**[5]	0.01	<0.01

[1]Based on dose-based EEC and iprodione Northern bobwhite quail acute oral LD_{50} = 930 mg/kg-bw
[2]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[5] RQ > acute risk to endangered species LOC of 0.1.

Table 47. Revised acute dietary-based RQs[1] for CRLF consuming different food items. EECs calculated using T-HERPS.

Use	Small insects	Large insects	Small herbivore mammals	Small insectivore mammals	Small terrestrial-phase amphibians
Almonds	<0.04	<0.01	<0.05	<0.01	<0.01
Beans	<0.05	<0.01	<0.05	<0.01	<0.01
Berries[2]	<0.07	<0.01	<0.09	<0.01	<0.01
Canola	<0.09	<0.01	<0.11	<0.01	<0.01
Carrots	<0.08	<0.01	<0.09	<0.01	<0.01
Cole Crops [3]	<0.09	<0.01	<0.11	<0.01	<0.01
Conifers	<0.10	<0.01	<0.12	<0.01	<0.01
Cotton	<0.01	<0.01	<0.01	<0.01	<0.01
Crucifer	<0.09	<0.01	<0.11	<0.01	<0.01
Garlic	<0.05	<0.01	<0.06	<0.01	<0.01
Grapes	<0.08	<0.01	<0.09	<0.01	<0.01
Lettuce (aerial)	<0.06	<0.01	<0.07	<0.01	<0.01
Lettuce (ground)	<0.07	<0.01	<0.09	<0.01	<0.01
Onions	<0.06	<0.01	<0.07	<0.01	<0.01
Ornamentals (drench high)	**<2.22**[5]	<0.25	**<2.61** [5]	<0.16	<0.08
Ornamentals (drench low)	<0.54	<0.06	<0.63	<0.04	<0.02
Ornamentals (foliar high)	<0.37	<0.04	<0.44	<0.03	<0.01
Ornamentals (foliar low)	<0.07	<0.01	<0.08	<0.01	<0.01
Peanuts	<0.06	<0.01	<0.07	<0.01	<0.01
Potatoes	<0.07	<0.01	<0.09	<0.01	<0.01
Radishes	<0.08	<0.01	<0.10	<0.01	<0.01
Rutabagas	<0.09	<0.01	<0.11	<0.01	<0.01
Stone Fruit[4]	<0.06	<0.01	<0.07	<0.01	<0.01
Strawberries	<0.02	<0.01	<0.03	<0.01	<0.01
Turf (sod)	<0.36	<0.04	<0.42	<0.03	<0.01
Turf (tees)	<0.34	<0.04	<0.40	<0.03	<0.01
Turnip greens	<0.09	<0.01	<0.11	<0.01	<0.01

[1]Based on dose-based EEC and iprodione Northern bobwhite quail subacute dietary LC_{50} >5,620 mg/kg-
[2]Specifically:blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[5]EEC exceeds highest test limit of sub-acute dietary study with Northern bobwhite quail (where no mortality was observed)

Chronic exposures

Preliminary chronic (dietary-based) RQ values generated using T-REX ranged from 1.05 to 48.8 across 19 of the 24 use categories evaluated. Revised chronic RQs for at least one prey item generated using T-HERPS exceed the LOC (1.0) for every use of iprodione, except almonds, beans, cotton and strawberries (**Table 48**). RQs are highest for CRLF consuming small herbivore mammals, with RQs that exceed the LOC ranging 1.13 to 48.8. RQs for CRLF consuming small insects exceed the LOC for the majority of iprodione uses with the exception of almonds, beans, cotton, garlic, onions, peanuts and strawberries, with RQs that exceed the LOC ranging 1.04 to 26.0. RQs for CRLF consuming large insects, small insectivore mammals and small terrestrial-phase amphibians exceed the LOC only for drench applications of iprodione to ornamentals.

It should be noted that the specific diet of the terrestrial-phase CRLF is unknown, and, therefore, the proportion of the diet that can be attributed to small and large insects, small herbivore mammals, small insectivore mammals and small terrestrial-phase amphibians is unknown. In order to bound the exposure of the terrestrial-phase CRLF to iprodione, separate RQs are developed for CRLF consuming 100% of each of its potential prey items. Since the CRLF is an opportunistic feeder, it is more likely that the diet will be composed of a mixture of these prey, with the specific proportion being dependant upon the available prey. Therefore, the highest RQs, which correspond to chronic exposures of the terrestrial-phase CRLF to iprodione through consumption of (100%) small herbivore mammals are not necessarily representative of the risk of the CRLF to iprodione.

The NOAEC used to derive RQs for the terrestrial-phase CRLF is 300 mg/kg diet, which is based on an avian reproduction study with Northern bobwhite quail (Fink *et al*. 1981*a*.), where statistically significant effects were observed at 1000 mg/kg-diet (LOAEC) in the number of eggs laid (24% decline), hatchling body weight (26% decline) and in the number of normal hatchlings out of eggs set (26% decline). RQs are based on a level where no effects are observed in a reproduction test. There is uncertainty associated with the level where effects can actually be expected, with that level falling somewhere between the NOAEC and the LOAEC. If EECs generated using T-HERPS are compared to the LOAEC (1,000 mg/kg-diet), the EECs for iprodione use on ornamentals and turf are sufficient to exceed the LOAEC.

Table 48. Revised chronic dietary-based RQs1 for CRLF consuming different food items. EECs calculated using T-HERPS.

Use	Small insects	Large insects	Small herbivore mammals	Small insectivore mammals	Small terrestrial-phase amphibians
Almonds	0.69	0.07	0.81	0.05	0.03
Beans	0.80	0.09	0.93	0.06	0.03
Berries[2]	**1.16**[5]	0.13	**1.36**[5]	0.08	0.04
Canola	**1.62**[5]	0.18	**1.89**[5]	0.12	0.06
Carrots	**1.38**[5]	0.15	**1.61**[5]	0.10	0.05
Cole Crops [3]	**1.62**[5]	0.18	**1.89**[5]	0.12	0.06
Conifers	**1.72**[5]	0.19	**2.01**[5]	0.13	0.06
Cotton	0.11	0.01	0.13	0.01	<0.01
Crucifer	**1.62**[5]	0.18	**1.89**[5]	0.12	0.06
Garlic	0.83	0.09	0.98	0.06	0.03
Grapes	**1.38**[5]	0.15	**1.61**[5]	0.10	0.05
Lettuce (aerial)	**1.04**[5]	0.11	**1.22**[5]	0.07	0.04
Lettuce (ground)	**1.27**[5]	0.14	**1.50**[5]	0.09	0.05
Onions	0.98	0.11	**1.13**[5]	0.07	0.04
Ornamentals (drench high)	**41.7**[5]	**4.63**[5]	**48.8**[5]	**3.05**[5]	**1.45**[5]
Ornamentals (drench low)	**9.40**[5]	**1.04**[5]	**11.0**[5]	0.69	0.32
Ornamentals (foliar high)	**6.98**[5]	0.78	**8.18**[5]	0.51	0.24
Ornamentals (foliar low)	**1.17**[5]	0.13	**1.38**[5]	0.08	0.04
Peanuts	0.98	0.11	**1.14**[5]	0.07	0.04
Potatoes	**1.27**[5]	0.14	**1.50**[5]	0.09	0.05
Radishes	**1.46**[5]	0.16	**1.71**[5]	0.11	0.05
Rutabagas	**1.62**[5]	0.18	**1.89**[5]	0.12	0.06
Stone Fruit[4]	**1.08**[5]	0.12	**1.25**[5]	0.07	0.04
Strawberries	0.42	0.05	0.49	0.03	0.02
Turf (sod)	**6.27**[5]	0.69	**7.36**[5]	0.46	0.22
Turf (tees)	**5.98**[5]	0.67	**7.00**[5]	0.44	0.20
Turnip greens	**1.62**[5]	0.18	**1.89**[5]	0.12	0.06

[1]Based on dietary-based EEC and iprodione Northern bobwhite quail NOAEC = 300 mg/kg-diet.
[2]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifically: apricots, cherries, nectarines, peaches, plums, prunes
[5]RQ> chronic risk LOC of 1.0

Spatial extent of risks to terrestrial-phase CRLF (due to spray drift transport)

EECs and relevant RQs (**Table 44-Table 48**) calculated by T-HERPS apply to sites where iprodione is directly applied. Since iprodione can be transported through spray drift to non-target areas beyond the treatment site, CLRFs outside of direct treatment areas can still be exposed to iprodione in non-target areas. Exposure and associated risks to the CRLF are expected to decrease with increasing distance away from the treated field or site of application.

Based on acute effects data, spray drift deposition of iprodione from a single application as low as 0.62 lbs a.i./A (calculated using T-HERPS) would be sufficient to exceed at least one LOC for the CRLF. For all uses of iprodione, this distance is estimated to extend <37 feet from the edge of the application site (**Table 49**).

Table 49. Distance from edge of field where spray drift transport from single aerial application rate does not exceed LOCs for exposures of the CRLF to iprodione.

Use(s)	Application method(s)	Max single application rate (lbs a.i./A)	Distance from edge of field (ft) where LOCs are not exceeded[1]
almonds	Ground, airblast and aerial spray	0.5	0
onions	ground and aerial spray	0.75	0
Beans, berries[1], canola, carrots, cole crops[2], crucifer, grapes, lettuce, peanuts, potatoes, radishes, strawberries, turnip greens	ground spray	1	3
Beans, berries[1], canola, carrots, cole crops[2], crucifer, grapes, lettuce, peanuts, potatoes, radishes, strawberries, turnip greens	airblast	1	0
Beans, berries[1], canola, carrots, cole crops[2], crucifer, grapes, lettuce, potatoes, radishes, strawberries, turnip greens	air spray	1	0
Conifers	ground spray	1.25	7
Conifers	Airblast (sparse trees)	1.25	0
Stone fruits[3]	ground spray	1.3725	7
Stone fruits[3]	ground spray	1.3725	0
Stone fruits[3]	air spray	1.3725	3
Ornamentals	ground spray	2.805	13
Turf	ground spray	8.16	36

[1]For a single application
[2]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifically: apricots, cherries, nectarines, peaches, plums, prunes

Summary of effects of iprodione on terrestrial-phase CRLF

Based on LOC exceedances for refined acute and chronic RQs for the terrestrial-phase CRLF, all uses of iprodione, except cotton, are likely to adversely affect the CRLF.

5.2.2 Indirect Effects (via Reductions in Prey Base)

5.2.2.1 Algae (non-vascular plants)

As discussed in Section 2.5.3, the diet of CRLF tadpoles is composed primarily of unicellular aquatic plants (*i.e*., algae and diatoms) and detritus. As discussed in Section 5.1.1.2 and as summarized in **Table 31**, RQs for non-vascular plants are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow treatment to cotton and all seed treatments are below the LOC.

Toxicity data for other aquatic plants include studies on the estuarine/marine diatom (*S. costatum* 120-hr EC_{50}=330 µg/L; Giddings 1990*a*), green algae (*P. subcapitata* 120-hr EC_{50}=1,800 µg/L; Giddings 1990*d*) and cyanobacteria (*A. flos-aquae* 120-hr EC_{50}>860 µg/L; Giddings 1990*e*). Compared to the most sensitive toxicity estimate for aquatic plants, *i.e*., *N. pelliculosa* EC_{50}= 50 µg/L, the other nonvascular aquatic plants tested are relatively insensitive.

As noted in section 5.2.1.1., there is considerable uncertainty in this assessment in the approach of modeling total residues of concern. If RQs were developed using EECs for iprodione only (**Table 41**), they would be sufficient to exceed the aquatic plant LOC for iprodione use on ornamentals and turf.

Although there are limited toxicity data available for the 3,5-DCA degradate, the compound appears to be less toxic to non-target species than the parent compound. Available toxicity data for 3,5-DCA in green algae indicate an EC_{50} of 7500 µg/L which is four times less toxic than the estimate for green algae (EC_{50} =1800 µg/L) tested with the parent compound.

To the extent that 3,5-DCA is less toxic and depending on the extent to which iprodione degrades to 3,5-DCA, the RQ values estimating potential risk to aquatic plants based on the toxicity of the parent compound and estimates of total toxic residues would be highly conservative. However, based on total residues and the most sensitive toxicity estimate for the parent compound, *i.e*., 50 µg/L, RQ values exceed the LOC by factors ranging from 1.2 to 154X.

5.2.2.2 Aquatic Invertebrates

The potential for iprodione to elicit indirect effects to the CRLF via effects on freshwater invertebrate food items is dependent on several factors including: (1) the potential magnitude of effect on freshwater invertebrate individuals and populations; and (2) the number of prey species potentially affected relative to the expected number of species needed to maintain the dietary needs of the CRLF. Together, these data provide a basis to evaluate whether the number of individuals within a prey species is likely to be reduced such that it may indirectly affect the CRLF.

As discussed in section 5.1.1.2, acute RQs for aquatic invertebrates exceed the LOC for all uses of iprodione, except cotton (in-furrow) and seed treatments to rutabagas and turnip greens. Chronic RQs exceed the LOC for all uses of iprodione, except cotton (in-furrow) and seed treatments of broccoli, Brussels sprouts, cabbage, cauliflower, kale, carrots, kohlrabi, radishes, rutabagas and turnip greens. Except for use on cotton, all RQs for uses where iprodione is applied via ground spray, chemigation or aerial spray are sufficient to exceed acute and chronic LOCs (**Table 32**).

With an acute 48-hr EC_{50} of 240 µg/L (McNamara 1990), iprodione is classified as highly toxic to freshwater invertebrates on an acute exposure basis. Two additional studies of *D. magna* are available, one by Roberts (1977) reported a 48-hr static LC_{50} of 382 µg/L. The second study by Vilkas (1977) reports a 48-hr LC_{50} of 7200 µg/L for *D. magna*. Although the studies by McNamara (1990) and Roberts (1977) have relatively consistent toxicity estimates for *D. magna*, the study by Vilkas is an order of magnitude less sensitive.

Although not reported in the original study nor in the EPA data evaluation record for the study by McNamara, the probit dose-response slope associated with the 48-hr EC_{50} is 3.45. This slope is used (in IEC v1.1) to estimate the probability of effects from acute exposures of aquatic invertebrates to iprodione residues of concern (**Table 50**). For uses that result in RQs that are close to the LOC, such as seed treatments to broccoli, Brussels sprouts, cabbage, cauliflower and kale (RQ = 0.06), the probability of effects to aquatic invertebrates is low (chance of <0.01%). For high uses of iprodione on ornamentals (26 applications per year), the probability of effects to aquatic invertebrates is approximately 100%

Table 50. Probability of mortality to aquatic invertebrates resulting from acute exposures to iprodione.

Use(s)	Invertebrate Acute RQ	Probability
Almonds	**0.71**[1]	30.51%
Beans	**0.93**[1]	45.83%
Broccoli, Brussels sprouts, cabbage, cauliflower, kale (seed treatment)	**0.06**[1]	<0.01%
Berries[2]	**1.34**[1]	66.85%
Canola (foliar)	**3.38**[1]	96.61%
Canola (seed treatment)	**0.18**[1]	0.50%
Carrot (foliar)	**1.87**[1]	82.64%
Carrot (seed treatment)	**0.07**[1]	<0.01%
Cole Crops[3] and crucifer	**4.91**[1]	99.15%
Conifers	**1.35**[1]	67.34%
Cotton	0.04	<0.01%
Garlic	**0.25**[1]	1.86%
Grapes	**1.33**[1]	66.40%
Kohlrabi (seed treatment)	**0.20**[1]	0.87%
Lettuce (aerial)	**2.75**[1]	93.52%
Lettuce (ground)	**3.03**[1]	95.18%
Onions	**1.12**[1]	56.85%
Ornamentals (drench - 1 application)	**6.56**[1]	99.76%
Ornamentals (drench - 26 applications)	**217**[1]	100.00%
Ornamentals (foliar-1 application)	**1.04**[1]	52.18%
Ornamentals (foliar-26 applications)	**32.0**[1]	100.00%
Peanuts	**0.88**[1]	42.29%
Potatoes	**1.17**[1]	59.34%
Radishes (foliar)	**1.49**[1]	72.57%
Radishes (seed treatment)	**0.07**[1]	0.00%
Rutabagas (foliar)	**1.45**[1]	71.11%
Rutabagas (seed treatment)	0.01	<0.01%
Stone Fruit[4]	**0.91**[1]	44.68%
Strawberries	**0.77**[1]	34.47%
Turf (golf course - greens, tees and aprons) (fall)	**5.75**[1]	99.56%
Turf (golf course - greens, tees and aprons) (spring)	**3.45**[1]	96.84%
Turf (golf course, sod farm, commercial industrial lawns) (fall)	**6.37**[1]	99.72%
Turf (golf course, sod farm, commercial industrial lawns) (spring)	**3.76**[1]	97.65%
Turnip greens (foliar)	**4.66**[1]	98.94%
Turnip greens (seed treatment)	**0.10**[1]	0.02%

[1] Exceeds acute risk LOC of 0.05.
[2] Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3] Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4] Specifically: apricots, cherries, nectarines, peaches, plums, prunes

As noted in section 5.2.1.1., there is considerable uncertainty in this assessment in the approach of modeling total residues of concern. If RQs were developed using EECs for iprodione only (**Table 41**), they would be sufficient to exceed the acute LOC for several uses of iprodione, including beans, canola carrots, cole crops, crucifer, conifers, grapes, lettuce, ornamentals, strawberries, turf, and turnip greens (applications via ground spray, chemigation or aerial spray). If chronic RQs were developed, they would be sufficient to exceed the LOC for iprodione use on ornamentals.

Available toxicity data indicate that 3,5-DCA is less toxic to aquatic animals than the parent compound. For waterfleas, 3,5-DCA (EC_{50} =1120 μg/L; Maas-Diepeveen and van Leeuwen 1986) is 5 times less toxic than the parent compound (48-hr EC_{50}=240 μg/L). If RQ values were derived using aquatic EECs generated for 3,5-DCA (**Table 43**) in combination with available acute toxicity data for 3,5-DCA the acute RQ for cotton would be below the LOC (0.05), while the acute RQ for 26 drench applications to ornamentals would be above the LOC.

To the extent that 3,5-DCA is less toxic and depending on the extent to which iprodione degrades to 3,5-DCA, the RQ values estimating potential risk to aquatic invertebrates based on the toxicity of the parent compound and estimates of total toxic residues would be highly conservative. However, based on total residues and the most sensitive toxicity estimate for the parent compound, *i.e*., 240 μg/L, RQ values exceed the LOC by factors ranging from 1 to 4,340X.

5.2.2.3 Fish and Aquatic-phase Frogs

As discussed in Section 5.2.1.1 (indirect effects to fish and frogs as food items are based on the direct effects analysis for aquatic-phase CRLFs), acute RQs for fish are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. Chronic RQs for fish are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments do not exceed LOCs.

Section 5.2.1.1 explores the likelihood of individual mortality to aquatic-phase CRLF exposed to total residues of iprodione as well as uncertainties associated with considering total residues of concern vs. only iprodione. The contents of section 5.2.1.1 also apply to characterization of indirect effects to aquatic-phase CRLF through effects to fish and aquatic-phase frogs that represent the prey of the CRLF. Therefore, based on the conclusions of section 5.2.1.1, there is potential for effects to fish and aquatic-phase amphibians from all iprodione uses that are applied via ground spray, chemigation or aerial spray. Effects are not expected from uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments.

5.2.2.4 Terrestrial Invertebrates

When the terrestrial-phase CRLF reaches juvenile and adult stages, its diet is mainly composed of terrestrial invertebrates. Iprodione is practically nontoxic to honeybees on an acute contact exposure basis. Since the honeybee acute contact LD_{50} value for iprodione is higher than the highest dosage tested, *i.e*., LD_{50}>120 µg/bee, all of the RQ values are less than the calculated value. For all but two of the uses evaluated, *i.e*., drench applications to ornamental plants and applications to turf, the EECs were less than the NOAEC value for bees (NOAEC=120 µg/bee) in the acute contact toxicity study, and mortality is not considered likely at these exposure levels. However, there is uncertainty regarding the potential effect on bees at the higher EECs for ornamental plants and turf.

Additionally, there is an incident report for honeybees indicating that iprodione exposure may result in deleterious effects on bee brood development. Honeybee larval and pupal development and survival were impaired by exposure of larvae to 0.5 µg/bee. If RQs were based on a toxicity value of 0.5 µg/bee and T-REX-estimated exposure concentrations, all of the RQ values would exceed the acute risk LOC. In a recent study by vanEnglesdorp *et al.* 2009, iprodione has been measured in wax samples collected from bee colonies; mean iprodione residue levels in wax were 48.9±21µg/kg. In unpublished data, Pennsylvania State University researchers have analyzed wax from 208 samples collected from commercial bee colonies; 6.7% of the wax samples contained iprodione residues with maximum iprodione residues of 636 µg/kg (personal communication: Dr. Chris Mullin, Department of Entomology, Pennsylvania State University, September 2, 2009). These data indicate that iprodione is detected in honeybee colonies where it can potentially affect brood development. It is presumed that the residues of iprodione detected in bee colonies are a result of registered uses of the fungicide. Given the uncertainty regarding the effects of iprodione on terrestrial invertebrates and the likely exposure, potential risk to terrestrial invertebrates cannot be precluded.

5.2.2.5 Mammals

Life history data for terrestrial-phase CRLFs indicate that large adult frogs consume terrestrial vertebrates, including mice. As discussed in Section 5.1.2.2.2 and summarized in **Table 36,** acute and chronic RQ values exceed acute and chronic LOCs. For all of the uses evaluated, chronic dose-based chronic RQ values exceed the chronic risk LOC by factors as high as 521X. The chronic, dietary-based RQ for mammals consuming iprodione-treated seeds is 278. Except for use on cotton, dietary-based RQ values exceed the chronic risk LOC by factors as high as 74X.

EECs and relevant RQs calculated by T-REX apply to sites where iprodione is directly applied. Since iprodione can be transported through spray drift to non-target areas beyond the treatment site, Small mammals (prey of CRLF) outside of direct treatment areas can still be exposed to iprodione in non-target areas. Exposure and associated risks to the small mammals are expected to decrease with increasing distance away from the treated field or site of application.

Based on acute and chronic effects data, spray drift deposition of iprodione <u>from a single application</u> as low as 0.17 lbs a.i./A (calculated using T-REX) would be sufficient to exceed at least one LOC for small mammals consuming short grass. For all uses of iprodione, this distance is estimated to extend <122 feet from the edge of the application site (**Table 51**).

Table 51. Distance from edge of field where spray drift transport from single aerial application rate does not exceed LOCs for exposures of the small mammals (consuming sort grass) to iprodione.

Use(s)	Application method(s)	Max single application rate (lbs a.i./A)	Distance from edge of field (ft) where LOCs are not exceeded[1]
almonds	ground and aerial spray	0.5	10
almonds	airblast	0.5	0
onions	ground spray	0.75	13
onions	aerial spray	0.75	26
Beans, berries[1], canola, carrots, cole crops[2], crucifer, grapes, lettuce, peanuts, potatoes, radishes, strawberries, turnip greens	ground spray	1	16
Beans, berries[1], canola, carrots, cole crops[2], crucifer, grapes, lettuce, peanuts, potatoes, radishes, strawberries, turnip greens	airblast	1	0
Beans, berries[1], canola, carrots, cole crops[2], crucifer, grapes, lettuce, potatoes, radishes, strawberries, turnip greens	air spray	1	52
Conifers	Ground spray	1.25	20
Conifers	Airblast (sparse trees)	1.25	20
Stone fruits[3]	ground spray	1.3725	23
Stone fruits[3]	airblast	1.3725	0
Stone fruits[3]	air spray	1.3725	79
Ornamentals	Ground spray	2.805	43
Turf	Ground spray	8.16	121

[1]For a single application
[2]Specifically: blackberries, blueberries, caneberries, currants, elderberries, gooseberries, huckleberries, loganberries, raspberries
[3]Specifically: broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi
[4]Specifially: apricots, cherries, nectarines, peaches, plums, prunes

Based on the acute and chronic risks posed by iprodione to mammals serving as prey, iprodione is considered likely to indirectly affect the CRLF for all uses.

5.2.2.6 Terrestrial-phase Amphibians

Terrestrial-phase adult CRLFs also consume frogs. RQ values representing direct exposures of iprodione to terrestrial-phase CRLFs are used to represent exposures of iprodione to frogs in terrestrial habitats. As discussed in Section 5.2.1.2 (indirect effects to frogs as food items are based on the direct effects analysis for terrestrial-phase CRLF) RQ values exceed the acute risk LOC by factors of 2.3 – 143X across all of the uses evaluated except for cotton. Chronic RQ values exceed the chronic risk LOC by factors ranging from 1.05 to 28X across 19 of the 24 uses evaluated. Based on the acute and chronic risks posed by iprodione to terrestrial-phase amphibians serving as prey, iprodione is considered likely to indirectly affect the CRLF.

5.2.3 Indirect Effects (via Habitat Effects)

5.2.3.1 Aquatic Plants (Vascular and Non-vascular)

Aquatic plants serve several important functions in aquatic ecosystems. Non-vascular aquatic plants are primary producers and provide the autochthonous energy base for aquatic ecosystems. Vascular plants provide structure as attachment sites and refugia for many aquatic invertebrates, fish, and juvenile organisms, such as fish and frogs. In addition, vascular plants also provide primary productivity and oxygen to the aquatic ecosystem. Rooted plants help reduce sediment loading and provide stability to nearshore areas and lower streambanks. In addition, vascular aquatic plants are important as attachment sites for egg masses of CRLFs.

Potential indirect effects to the CRLF based on impacts to habitat and/or primary production were assessed using RQs from freshwater aquatic vascular and non-vascular plant data. Based on the available data for vascular plants, iprodione is likely to affect vascular aquatic plants for uses other than cole crops, canola, carrots, cotton, Kohlrabi (seed treatment), rutabagas and turnip greens (seed treatment). Of the uses evaluated for nonvascular plants, all uses except cole, canola, carrots, cotton, kohlrabi (seed treatment), radishes, rutabagas and turnip greens the application of iprodione to ornamental plants exceeded the LOC. Based on the number of exceedances, iprodione could indirectly adversely affect the CRLF through reduction in vascular and nonvascular aquatic plants.

5.2.3.2 Terrestrial Plants

Terrestrial plants serve several important habitat-related functions for the CRLF. In addition to providing habitat and cover for invertebrate and vertebrate prey items of the CRLF, terrestrial vegetation also provides shelter for the CRLF and cover from predators while foraging. Terrestrial plants also provide energy to the terrestrial ecosystem through primary production. Upland vegetation including grassland and woodlands provides cover during dispersal. Riparian vegetation helps to maintain the integrity of aquatic systems by providing bank and thermal stability, serving as a buffer to filter out sediment,

nutrients, and contaminants before they reach the watershed, and serving as an energy source.
Due to a lack of effects data for terrestrial plants exposed to iprodione, there is uncertainty regarding the chemical's potential effect on terrestrial plants that provide cover for terrestrial environment; therefore, risk is presumed. To further bolster concerns for potential adverse effects on terrestrial plants, there are ecological incidents reported in the EIIS indicating terrestrial plant damage following the application of iprodione. As a result, there is potential for indirect effects to the CRLF due to effects to plants in its terrestrial habitat.

5.2.4 Modification to Designated Critical Habitat

5.2.4.1 Aquatic-Phase PCEs

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

Conclusions for potential indirect effects to the CRLF via direct effects to aquatic and terrestrial plants are used to determine whether modification to critical habitat may occur. At some of the higher application rates assessed, iprodione use could result in the loss of nonvascular aquatic plants. Additionally, there is uncertainty regarding the potential for iprodione to affect terrestrial plants; however, there are at least 14 incident reports in the EIIS indicating that terrestrial plants can be damaged by direct exposure to iprodione. As such, there is a potential for habitat modification via impacts to aquatic plants (Sections 5.2.2.1 and 5.2.3.1) and terrestrial plants (5.2.3.2).

The remaining aquatic-phase PCE is "alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source." Other than impacts to algae as food items for tadpoles (discussed above), this PCE is assessed by considering direct and indirect effects to the aquatic-phase CRLF via acute and chronic freshwater fish and invertebrate toxicity endpoints as measures of effects. Impacts to aquatic invertebrates, fish and aquatic-phase amphibians (Section 5.2.2.2) are considered likely and as a result indirectly impact the CRLF through reduction in available prey.

5.2.4.2 Terrestrial-Phase PCEs

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance.

- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.

As stated previously, there is uncertainty regarding the potential for iprodione to affect terrestrial plants; however, there are at least 14 incident reports in the EIIS indicating that terrestrial plants can be damaged by direct exposure to iprodione. As such, there is a potential for habitat modification via impacts to terrestrial plants (Section 5.2.3.2).

The third terrestrial-phase PCE is "reduction and/or modification of food sources for terrestrial phase juveniles and adults." To assess the impact of iprodione on this PCE, acute and chronic toxicity endpoints for terrestrial invertebrates, mammals, and terrestrial-phase frogs are used as measures of effects. Given the uncertainty regarding potential effects on terrestrial invertebrates and given the likely effects of iprodione on mammals and terrestrial-phase amphibians that serve as prey for CRLF, there is a potential for habitat modification via indirect effects to terrestrial-phase CRLFs via reduction in prey base (Section 5.2.2.4 for terrestrial invertebrates, Section 5.2.2.5 for mammals, and 5.2.2.6 for frogs).

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. As described in Section 5.2.1.2, terrestrial-phase CRLF are considered likely to be directly adversely affected by chronic exposure to iprodione. Additionally, as discussed in Section 5.2.2.4, there is uncertainty regarding the potential effects of iprodione on the development and survival of terrestrial invertebrates following chronic exposure to the fungicides and risk to these prey items is considered possible. Iprodione is also considered likely to result in both acute and chronic effects on small mammals (Section 5.2.2.5), fish and aquatic-phase amphibians (Section 5.2.2.6) that serve as prey for the CRLF and as a result indirect effects to terrestrial-phase CRLFs are considered likely.

5.2.5 Addressing the Risk Hypotheses

In order to conclude this risk assessment, it is necessary to address the risk hypotheses defined in section 2.9.1. Based on the conclusions of this assessment, none of the hypotheses can be rejected, meaning that the stated hypotheses represent concerns in terms of direct and indirect effects of iprodione on the CRLF and its designated critical habitat.

6.0 Uncertainties

6.1 Exposure Assessment Uncertainties

6.1.1 Environmental Fate Data

Submitted iprodione degradation studies involving soils are characterized by high levels of unextracted and unidentified residues which lead to uncertain degradation characterizations. For example, in a submitted aerobic soil degradation study, 75 to 87% of the residues were unextracted and uncharacterized after 300 days. Thus, it remains unknown if and how much of these residues are parent iprodione or degradates of concern. It is also unclear as to the extent to which they may be bound into the soil matrix. Nevertheless, terrestrial and aquatic field dissipation studies tend to imply that iprodione dissipates in the environment with a DT_{50} of 3 to 7 days. However, because of the extraction concerns raised in the soil studies, it is unknown whether these DT_{50} values represent true degradation or simply a temporary sequestering of iprodione (or degradates of concern) that can be released over time. In the case that 3,5-DCA may covalently bond to organic matter, this binding can result in tight adsorption to soil and reduce its likelihood to leave the treatment site. However, given that 3,5-DCA has been detected in surface and ground water samples collected by the USGS NAWQA program, some 3,5-DCA is still unbound and available to reach water.

6.1.2 Maximum Use Scenario

The screening-level risk assessment focuses on characterizing potential ecological risks resulting from a maximum use scenario, which is determined from labeled statements of maximum application rate and number of applications with the shortest time interval between applications. The frequency at which actual uses approach this maximum use scenario may be dependant on pest resistance, timing of applications, cultural practices, and market forces.

In the case of the ornamental use, the maximum number of applications that may be made in 1 year is not specified on the label. In order to bound the EECs that may result for this use, a minimum application per year of 1 was modeled as well as a maximum of 26 per year (based on the minimum application interval of 14 d for drench and the limit of 26 applications per year in the pe5 shell for foliar applications).

6.1.3 Aquatic Exposure Modeling of Iprodione

The standard ecological water body scenario (EXAMS pond) used to calculate potential aquatic exposure to pesticides is intended to represent conservative estimates, and to avoid underestimations of the actual exposure. The standard scenario consists of application to a 10-hectare field bordering a 1-hectare, 2-meter deep (20,000 m^3) pond with no outlet. Exposure estimates generated using the EXAMS pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and lower order streams. As a group, there are factors that make these water bodies more or less vulnerable than the EXAMS pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the EXAMS pond. These water bodies will be either smaller in size or have larger drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the EXAMS pond has no discharge. As watershed size increases beyond 10-hectares, it becomes increasingly unlikely that the entire watershed is planted with a single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the EXAMS pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

The Agency acknowledges that there are some unique aquatic habitats that are not accurately captured by this modeling scenario and modeling results may, therefore, under- or over-estimate exposure, depending on a number of variables. For example, aquatic-phase CRLFs may inhabit water bodies of different size and depth and/or are located adjacent to larger or smaller drainage areas than the EXAMS pond. The Agency does not currently have sufficient information regarding the hydrology of these aquatic habitats to develop a specific alternate scenario for the CRLF. CRLFs prefer habitat with perennial (present year-round) or near-perennial water and do not frequently inhabit vernal (temporary) pools because conditions in these habitats are generally not suitable (Hayes and Jennings 1988). Therefore, the EXAMS pond is assumed to be representative of exposure to aquatic-phase CRLFs. In addition, the Services agree that the existing EXAMS pond represents the best currently available approach for estimating aquatic exposure to pesticides (USFWS/NMFS 2004).

In general, the linked PRZM/EXAMS model produces estimated aquatic concentrations that are expected to be exceeded once within a ten-year period. The Pesticide Root Zone Model is a process or “simulation” model that calculates what happens to a pesticide in an agricultural field on a day-to-day basis. It considers factors such as rainfall and plant transpiration of water, as well as how and when the pesticide is applied. It has two major components: hydrology and chemical transport. Water movement is simulated by the use of generalized soil parameters, including field capacity, wilting point, and saturation water content. The chemical transport component can simulate pesticide application on the soil or on the plant foliage. Dissolved, adsorbed, and vapor-phase concentrations in the soil are estimated by simultaneously considering the processes of pesticide uptake by plants, surface runoff, erosion, decay, volatilization, foliar wash-off, advection, dispersion, and retardation.

Uncertainties associated with each of these individual components add to the overall uncertainty of the modeled concentrations. Additionally, model inputs from the environmental fate degradation studies are chosen to represent the upper confidence bound on the mean values that are not expected to be exceeded in the environment approximately 90 percent of the time. Mobility input values are chosen to be representative of conditions in the environment. The natural variation in soils adds to the uncertainty of modeled values. Factors such as application date, crop emergence date, and canopy cover can also affect estimated concentrations, adding to the uncertainty of modeled values. Factors within the ambient environment such as soil temperatures, sunlight intensity, antecedent soil moisture, and surface water temperatures can cause actual aquatic concentrations to differ for the modeled values.

Unlike spray drift, tools are currently not available to evaluate the effectiveness of a vegetative setback on runoff and loadings. The effectiveness of vegetative setbacks is highly dependent on the condition of the vegetative strip. For example, a well-established, healthy vegetative setback can be a very effective means of reducing runoff and erosion from agricultural fields. Alternatively, a setback of poor vegetative quality or a setback that is channelized can be ineffective at reducing loadings. Until such time as a quantitative method to estimate the effect of vegetative setbacks on various conditions on pesticide loadings becomes available, the aquatic exposure predictions are likely to overestimate exposure where healthy vegetative setbacks exist and underestimate exposure where poorly developed, channelized, or bare setbacks exist.

6.1.4 Potential Ground water Contributions to Surface Water Chemical Concentrations

Although the potential impact of discharging ground water on CRLF populations is not explicitly delineated, it should be noted that ground water could provide a source of pesticide to surface water bodies – especially low-order streams, headwaters, and ground water-fed pools. This is particularly likely if the chemical is persistent and mobile. Soluble chemicals that are primarily degrade by photolysis will be very likely to persist in ground water, and can be transportable over long distances. Similarly, many chemicals degrade slowly under anaerobic conditions (common in aquifers) and are thus more persistent in ground water. Much of this ground water will eventually be discharged to the surface – often supporting stream flow in the absence of rainfall. Continuously flowing low-order streams in particular are sustained by ground water discharge, which can constitute 100% of stream flow during baseflow (no runoff) conditions. Thus, it is important to keep in mind that pesticides in ground water may have a major (detrimental) impact on surface water quality, and on CRLF habitats.

SciGrow was used in this assessment to determine likely 'high-end' ground water vulnerability, with the assumption (based upon persistence in sub- and anoxic conditions, and mobility) that much of the compound entering the ground water will be transported some distance and eventually discharged into surface water. Although concentrations in a receiving water body resulting from ground water discharge cannot be explicitly quantified, it should be assumed that significant attenuation and retardation of the chemical will have occurred prior to discharge. Nevertheless, ground water could still be a significant consistent source of chronic background concentrations in surface water, and may also add to surface runoff during storm events (as a result of enhanced ground water discharge typically characterized by the 'tailing limb' of a storm hydrograph).

As noted in section 3.1.9, 3,5-DCA has been detected in ground water samples collected in CA. The maximum detected concentration of 3,5-DCA was 0.0983 µg/L (USGS 2009). This indicates that iprodione's degradate of concern has the potential to reach ground water.

6.1.5 Usage Uncertainties

County-level usage data were obtained from California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. Four years of data (2002 – 2005) were included in this analysis because statistical methodology for identifying outliers, in terms of area treated and pounds applied, was provided by CDPR for these years only. No methodology for removing outliers was provided by CDPR for 2001 and earlier pesticide data; therefore, this information was not included in the analysis because it may misrepresent actual usage patterns. CDPR PUR documentation indicates that errors in the data may include the following: a misplaced decimal; incorrect measures, area treated, or units; and reports of diluted pesticide concentrations. In addition, it is possible that the data may contain reports for pesticide uses that have been cancelled. The CPDR PUR data does not include home owner applied pesticides; therefore, residential uses are not likely to be reported. As with all pesticide usage data, there may be instances of misuse and misreporting. The Agency made use of the most current, verifiable information; in cases where there were discrepancies, the most conservative information was used.

6.1.6 Terrestrial Exposure Modeling of Iprodione

The Agency relies on the work of Fletcher *et al.* (1994) for setting the assumed pesticide residues in wildlife dietary items. These residue assumptions are believed to reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify. It is important to note that the field measurement efforts used to develop the Fletcher estimates of exposure involve highly varied sampling techniques. It is entirely possible that much of these data reflect residues averaged over entire above ground plants in the case of grass and forage sampling.

It was assumed that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy differences. Direct comparison of a laboratory dietary concentration- based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 – 2.5 for most food items.

Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 – 80%, and mammal's assimilation ranges from 41 – 85% (U.S. Environmental Protection Agency, 1993). If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (*e.g.,* a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

For the terrestrial exposure analysis of this risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

Given that no suitable data on interception and subsequent dissipation from foliar surfaces is available for iprodione residues of concern, the EFED default foliar dissipation half-life of 35 days is used based on the work of Willis and McDowell (1987). This represents an uncertainty in the terrestrial exposure assessment in that the actual dissipation of iprodione residues of concern from the terrestrial environment is unknown. The use of the 35-d value is assumed to be conservative.

6.1.7 Spray Drift Modeling

Although there may be multiple iprodione applications at a single site, it is unlikely that the same organism would be exposed to the maximum amount of spray drift from every application made. In order for an organism to receive the maximum concentration of iprodione from multiple applications, each application of iprodione would have to occur under identical atmospheric conditions (*e.g.,* same wind speed and – for plants – same wind direction) and (if it is an animal) the animal being exposed would have to be present directly downwind at the same distance after each application. Although there may be sites where the dominant wind direction is fairly consistent (at least during the relatively quiescent conditions that are most favorable for aerial spray applications), it is nevertheless highly unlikely that plants in any specific area would receive the maximum amount of spray drift repeatedly. It appears that in most areas (based upon available meteorological data) wind direction is temporally very changeable, even within the same day. Additionally, other factors, including variations in topography, cover, and meteorological conditions over the transport distance are not accounted for by the

AgDRIFT model (*i.e.*, it models spray drift from aerial and ground applications in a flat area with little to no ground cover and a steady, constant wind speed and direction). Therefore, in most cases, the drift estimates from AgDRIFT may overestimate exposure even from single applications, especially as the distance increases from the site of application, since the model does not account for potential obstructions (*e.g.*, large hills, berms, buildings, trees, *etc*.). Furthermore, conservative assumptions are made regarding the droplet size distributions being modeled ('ASAE Very Fine' for agricultural uses), the application method (*e*.g., aerial), release heights and wind speeds. Alterations in any of these inputs would change the area of potential effect.

6.2 Effects Assessment Uncertainties

6.2.1 Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies, mayflies, and third instar for midges).

Testing of juveniles may overestimate toxicity at older age classes for pesticide active ingredients that act directly without metabolic transformation because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, this assessment uses the most sensitive life-stage information as measures of effect for surrogate aquatic animals, and is therefore, considered as protective of the CRLF.

6.2.2 Use of Surrogate Species Effects Data

Guideline toxicity tests and open literature data on iprodione are not available for frogs or any other aquatic-phase amphibian; therefore, freshwater fish are used as surrogate species for aquatic-phase amphibians. Therefore, endpoints based on freshwater fish ecotoxicity data are assumed to be protective of potential direct effects to aquatic-phase amphibians including the CRLF, and extrapolation of the risk conclusions from the most sensitive tested species to the aquatic-phase CRLF is likely to overestimate the potential risks to those species. Efforts are made to select the organisms most likely to be affected by the type of compound and usage pattern; however, there is an inherent uncertainty in extrapolating across phyla. In addition, the Agency's LOCs are intentionally set very low, and conservative estimates are made in the screening level risk assessment to account for these uncertainties.

6.2.3 Sublethal Effects

When assessing acute risk, the screening risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide, as determined by the testing of species response to chronic exposure conditions and subsequent chronic risk assessment. Consideration of additional sublethal data in the effects determination t is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints. However, the full suite of sublethal effects from valid open literature studies is considered for the purposes of defining the action area.

Iprodione has been demonstrated to affect steroidogenesis, and more specifically, inhibition of testosterone synthesis in testicular Leydig cells. As such the chemical is capable of acting on endocrine-mediated processes. Available data for iprodione indicate that it affects reproductive endpoints across a range of taxa. Since the terminal degradate of iprodione, *i.e*, 3,5-DCA, is classified as a "likely" carcinogen (USEPA 1998*b*) and may act through a different mode of action than the parent compound, there are a number of sublethal effects that could be associated with iprodione This assessment has attempted to account for sublethal effects by setting the initial area of concern as the entire State of California. To the extent to which sublethal effects are not considered in this assessment, the potential direct and indirect effects of iprodione on CRLF may be underestimated.

6.2.4 Location of Wildlife Species

For the terrestrial exposure analysis of this risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

7.0 Risk Conclusions

In fulfilling its obligations under Section 7(a)(2) of the Endangered Species Act, the information presented in this endangered species risk assessment represents the best data currently available to assess the potential risks of iprodione to the CRLF and its designated critical habitat.

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the CRLF from the use of iprodione. The Agency has determined that there is the potential for modification of CRLF designated critical habitat from the use of the chemical. All of the uses of iprodione might affect the frog and its critical habitat. Although the higher application rates modeled for drench applications to ornamental plants exceed the acute risk LOC for direct effects to CRLF, the likelihood of individual mortality is less than 1 in a million and as such, the potential for adverse effects is considered discountable. However, based on chronic RQ values that exceed the LOC, chronic effects of iprodione on reproduction could directly adversely affect the terrestrial-phase CRLF. Effects on aquatic nonvascular plants and aquatic invertebrates that serve as the forage base for aquatic-phase CRLF are also likely to be adversely affected and in turn affect the CRLF. Effects on terrestrial-phase amphibians, mammals, terrestrial insect that serve as forage for terrestrial-phase CRLF are likely to indirectly adversely affect the CRLF. Additionally, there is uncertainty regarding the effects of iprodione on terrestrial plants; however, there are incident data indicating terrestrial plant damage from registered uses of iprodione. With the uncertainty regarding the toxicity of iprodione to terrestrial plants and the incident data, risk is presumed to terrestrial plants and it is determined that iprodione uses in California are assumed likely to indirectly adversely affect the CRLF through reduced riparian cover. Given the LAA determination for the CRLF and potential modification of designated critical habitat, a description of the baseline status and cumulative effects for the CRLF is provided in Attachment II.

The LAA effects determination applies to those areas where it is expected that the pesticide's use will directly or indirectly affect the CRLF or its designated critical habitat. To determine this area, the footprint of iprodione's use pattern is identified, using land cover data that correspond to iprodione's use pattern. The spatial extent of the LAA effects determination also includes areas beyond the initial area of concern that may be impacted by runoff and/or spray drift. The identified direct and indirect effects and modification to critical habitat are anticipated to occur only for those currently occupied core habitat areas, CNDDB occurrence sections, and designated critical habitat for the CRLF that overlap with the initial area of concern plus 121 feet from its boundary, based on a single application of iprodione. It is assumed that non-flowing waterbodies (or potential CRLF habitat) are included within this area.

A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat, given the uncertainties discussed in Section 6, is presented in **Table 52** and **Table 53**.

Table 52. Effects Determination Summary for Iprodione Use and the CRLF.

Assessment Endpoint	Effects Determination	Basis for Determination
Survival, growth, and/or reproduction of CRLF individuals	Likely to adversely affect (LAA) for all uses	**Potential for Direct Effects**
		Aquatic-phase (Eggs, Larvae, and Adults): Acute RQs based on **iprodione residues of concern** for aquatic-phase CRLF are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21 $x10^{35}$). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1. Chronic RQs for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (*i.e.*, cotton and garlic) and seed treatments do not exceed LOCs. If RQs were developed using EECs for iprodione only and for 3,5-DCA only, for high use on ornamentals (26 applications per year), they would be sufficient to exceed acute and chronic LOCs for the aquatic-phase CRLF. there is an incident report involving a fish kill associated with the use of iprodione on golf course turf.
		Terrestrial-phase (Juveniles and Adults): Preliminary acute RQs (generated using T-REX) exceed the level of concern for all uses of iprodione, except cotton. Refined acute, dose-based RQs (generated using T-HERPS) for the small CRLF consuming small insects exceed the LOC for drench applications of iprodione on ornamentals. The likelihood of individual mortality to small CRLF exposed to iprodione from drench applications ranges 1 in 10 to 1 in $8.9x10^{18}$. Refined acute, dose-based RQs for the medium CRLF consuming small herbivore mammals exceed the LOC for all uses of iprodione, except cotton. The likelihood of individual mortality for the medium CRLF is as high as 1 in 1. Refined acute, dose-based RQs for the large CRLF exceed the LOC for iprodione use on canola, cole crops, conifers, crucifer, ornamentals, rutabagas, turf and turnip greens. The likelihood of individual mortality for the large CRLF is as high as 1 in 1. Preliminary chronic (dietary-based) RQ values generated using T-REX ranged from 1.04 to 38.6 across 19 of the 24 use categories evaluated. Revised chronic RQs for at least one prey item generated using T-HERPS exceed the LOC (1.0) for every use of iprodione, except almonds, cotton and strawberries. In addition, EECs for iprodione use on ornamentals and turf are sufficient to exceed the LOAEC. For all uses of iprodione, spray drift exposure is of concern <37 feet from the edge of the application site.
		Potential for Indirect Effects
		Aquatic prey items, aquatic habitat, cover and/or primary productivity RQs for non-vascular plants are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow

Assessment Endpoint	Effects Determination	Basis for Determination
		treatment to cotton and all seed treatments are below the LOC. All aquatic invertebrate RQs for uses where iprodione is applied via ground spray, chemigation or aerial spray are sufficient to exceed acute and chronic LOCs Acute RQs based on **iprodione residues of concern** for fish and aquatic-phase amphibians are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21 x10^{35}). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1. Chronic RQs for fish and aquatic-phase amphibians are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (i.e., cotton and garlic) and seed treatments do not exceed LOCs. Based on the above information, there is potential for indirect effects to the aquatic-phase CRLF from use of iprodione.
		Terrestrial prey items, riparian habitat Acute risk to terrestrial invertebrates could potentially exceed the LOC for uses of iprodione on ornamental plants and turf. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Chronic RQ values exceed the chronic risk LOC for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF. There is considerable uncertainty regarding the effects of iprodione on terrestrial invertebrates and based on incident data, risk is presumed. There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants.

Table 53. Effects Determination Summary for Iprodione Use and CRLF Critical Habitat Impact Analysis.

Assessment Endpoint	Effects Determination	Basis for Determination
Modification of aquatic-phase PCE	Habitat Modification	There is uncertainty (due to a lack of effects data for plants) regarding the chemical's potential effect on terrestrial plants that provide [riparian] cover for aquatic environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants. RQs for non-vascular plants that may serve as a forage base for aquatic-phase CRLF are sufficient to exceed the LOC (1.0) for all iprodione uses that are applied via ground spray, chemigation or air spray. The RQ for soil in-furrow treatment of garlic also exceeds the LOC. RQs for soil in-furrow treatment to cotton and all seed treatments are below the LOC. All aquatic invertebrate RQs for uses where iprodione is applied via ground spray, chemigation or aerial spray are sufficient to exceed acute and chronic LOCs Acute RQs based on **iprodione residues of concern** for fish and aquatic-phase amphibians are sufficient to exceed the LOC (0.05) for all iprodione uses that are applied via ground spray, chemigation or air spray. For uses that result in RQs that are close to the LOC, such as almonds (RQ = 0.06), the chance of individual mortality to an aquatic-phase CRLF is low (chance of 1 in 8.21 $x10^{35}$). For high uses of iprodione on ornamentals (26 applications per year), the chance of individual mortality to an aquatic-phase CRLF is approximately 1 in 1. Chronic RQs for fish and aquatic-phase amphibians are sufficient to exceed the LOC (1.0) for the majority of iprodione uses that are applied via ground spray, chemigation or air spray, with the exception of almonds, beans, peanuts, stone fruit and strawberries. Acute and chronic RQs for uses that are applied via soil in-furrow treatment (*i.e.*, cotton and garlic) and seed treatments do not exceed LOCs.
Modification of terrestrial-phase PCE		There is uncertainty regarding the chemical's potential effect on terrestrial plants that provide cover for the terrestrial environment; therefore, risk is presumed. Additionally, there are incident reports involving terrestrial plants where registered uses of iprodione resulted in damage to plants. Acute risk to terrestrial invertebrates could potentially exceed the level of concern for uses of iprodione on ornamental plants and turf. Additionally, there is uncertainty regarding the potential effects of iprodione on larval terrestrial invertebrates and risk is presumed based on an incident report. Acute dose-based RQ values and chronic RQ values exceed the acute and chronic risk LOCs for small mammals serving as prey. Chronic RQ values exceed the chronic risk LOC for terrestrial-phase amphibians serving as prey for terrestrial-phase CRLF. Dietary-based chronic RQ values exceed the chronic risk LOC for terrestrial-phase amphibians by factors as high as 28X and as such, available mammalian prey items may be reduced in CRLF habitat.

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (i.e., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (i.e., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

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